The Living Building Challenge
or LEED:

HOW THE BULLITT CENTER BECAME THE WORLD'S GREENEST COMMERCIAL BUILDING

MILLER | HULL

PAE


BUILDINGS
ACCOUNT FOR:
75%
OF TOTAL
ELECTRICAL USE
IN THE USA


BUILDINGS
ACCOUNT FOR:
46%
OF TOTAL
CO2 EMISSIONS
IN THE USA

BUILDINGS
ACCOUNT FOR:

136M

TONS OF WASTE
IN THE USA ANNUALLY

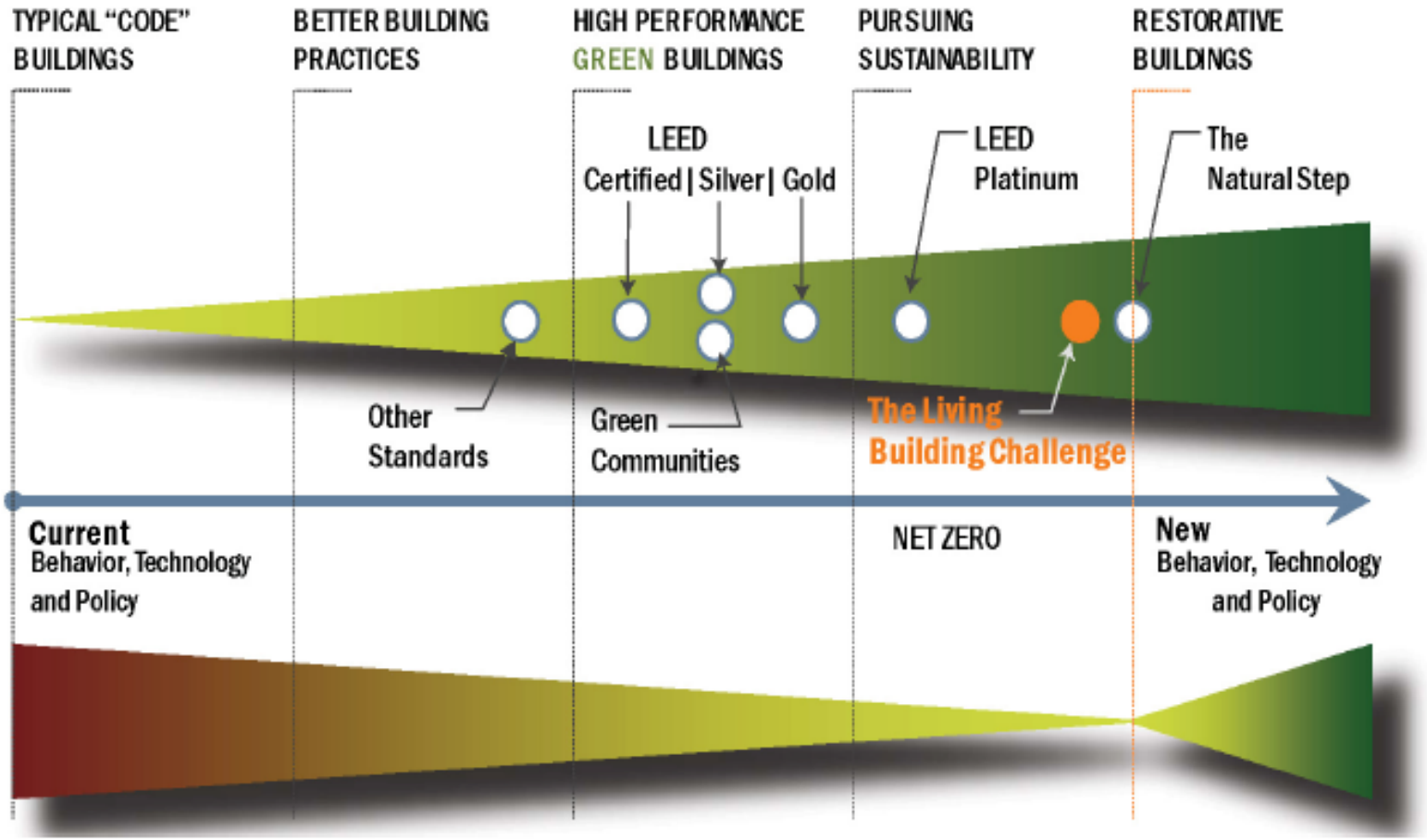
LIVING BUILDING CHALLENGE ADOPTED

credit: Interface Engineering & Central City Concern

LBC is the the most rigorous green-building benchmark available today

» goal is to be water & energy independent

» that means buckets of water & money saved



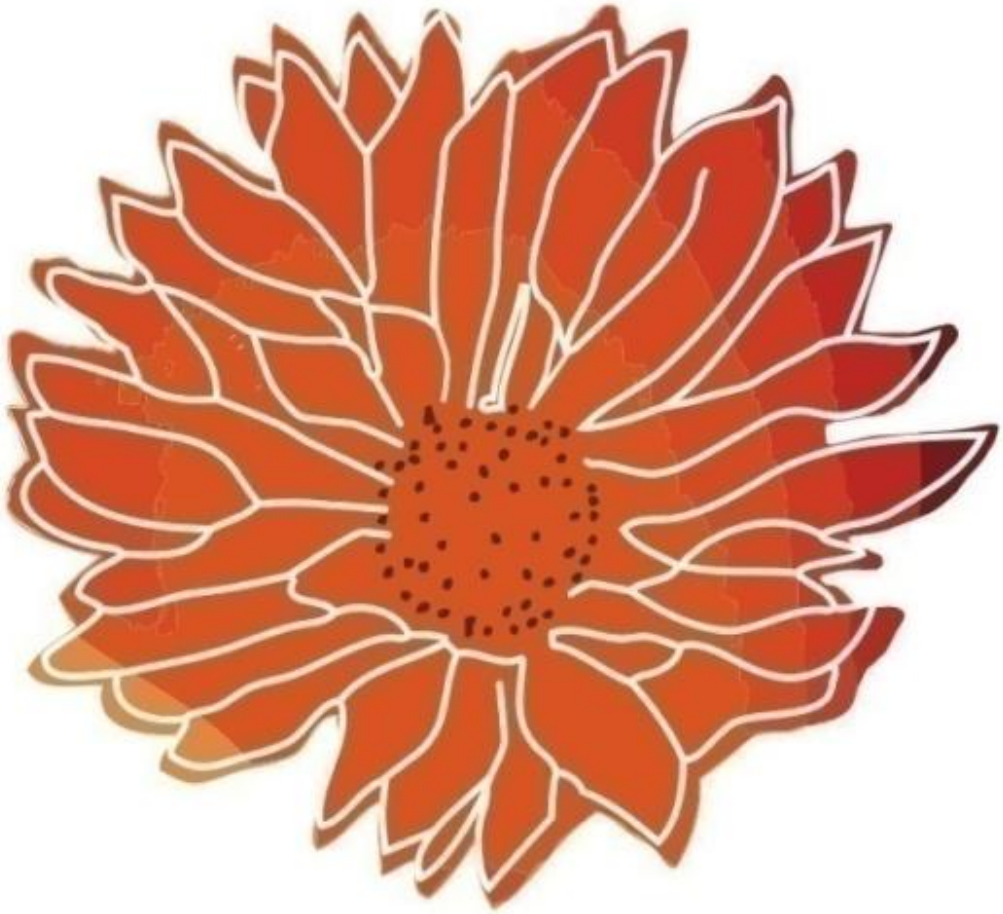
LEED PLATINUM

CASCADIA COMMUNITY COLLEGE

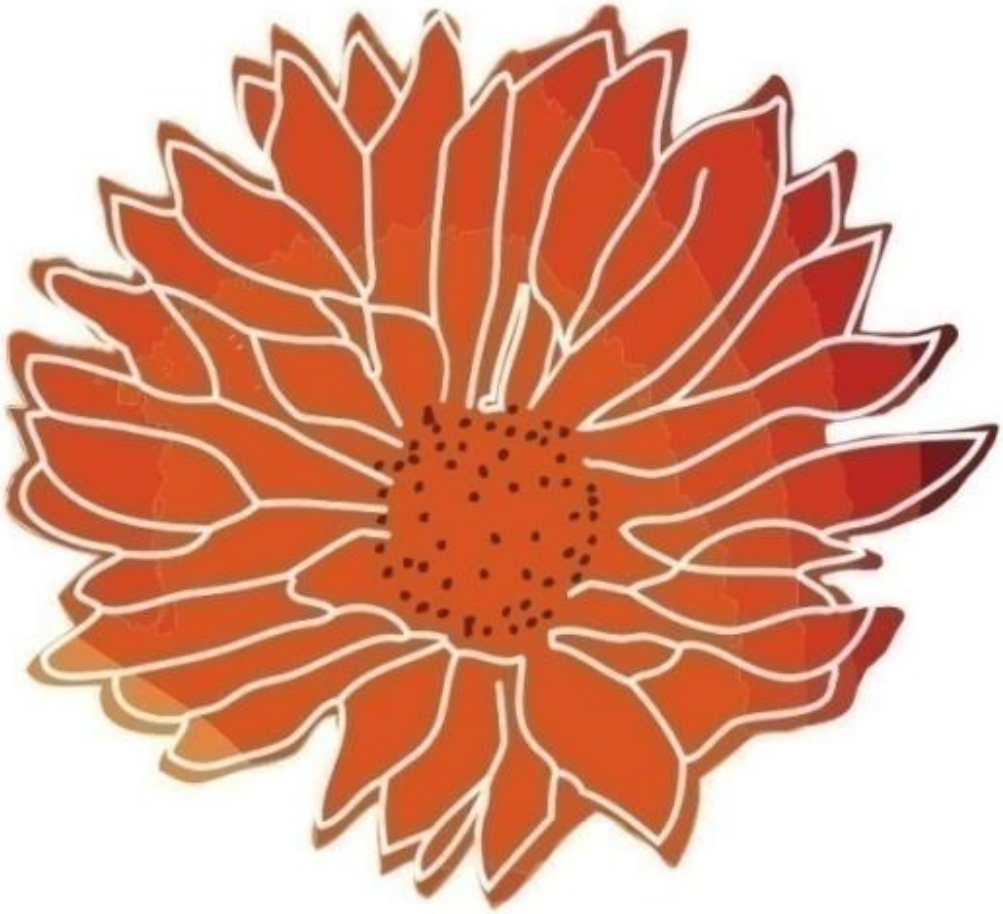
Global Learning & the Arts

THE LIVING BUILDING CHALLENGE

A PERFORMANCE BASED STANDARD



meet all the imperatives

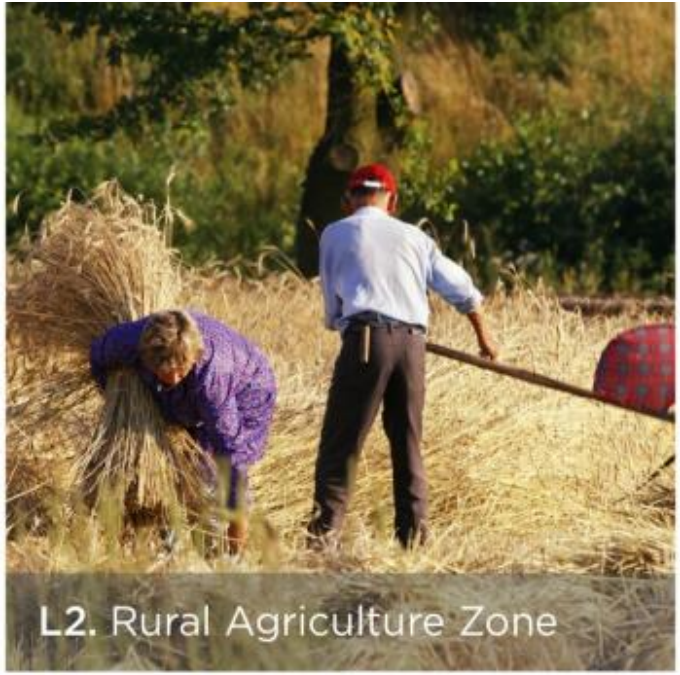


measure the results

2 RULES

4 TYPOLOGIES


L1. Natural Habitat Preserve


L2. Rural Agriculture Zone

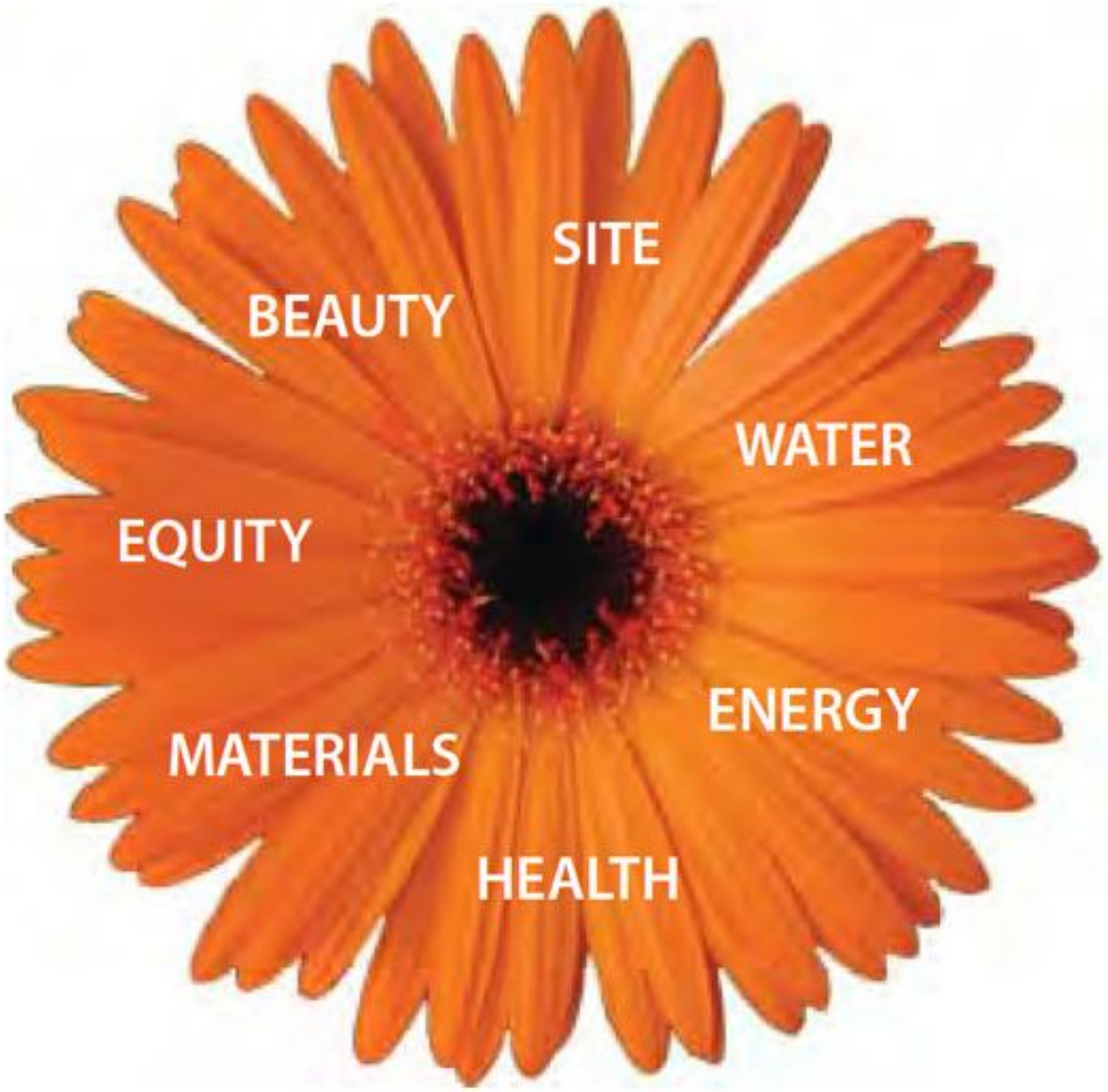

ee
hop
L3. Village or Campus Zone


EAST
20
L4. General Urban Zone


L5. Urban Center Zone


L6. Urban Core Zone

6 TRANSECTS



7 PETALS

Projects may only be on greyfields or brownfields – previously developed sites that are not on or adjacent to:
- sensitive ecological habitats (wetlands, primary dunes, old-growth forest, virgin prairie);
- prime farmland;
- within the 100-year flood plain.

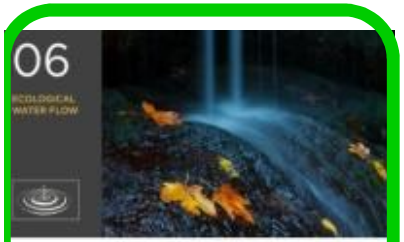
All projects must integrate opportunities for agriculture appropriate to the scale and density of the project using its Floor Area Ratio (F.A.R.) as the basis for calculation.

For each hectare of development, an equal amount of land must be set aside in perpetuity as part of a habitat exchange.

Each new project should contribute towards the creation of walkable, pedestrian-oriented communities.

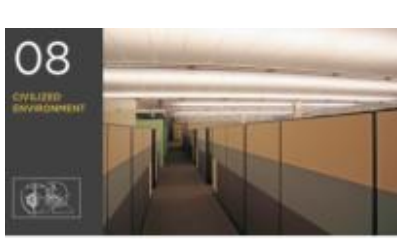
Consider the proportion of the following occupancy types surrounding the project site:
a. Residential
b. Commercial or institutional
c. Office or light-industrial

100% occupants' water use must come from captured precipitation or closed loop water systems that account for downstream ecosystem impacts and that are appropriately purified without the use of chemicals.



100% storm water and building water discharge must be managed onsite to feed the project's internal water demands or released onto adjacent sites for management in ecologically acceptable natural time scale surface flow, groundwater recharge, aquifer

100% energy needs must be supplied by on-site renewable energy on a net annual



Every occupiable space must have operable windows that provide access to fresh air and daylight.

To promote good indoor air quality, Renovations, Buildings, and buildings completed as part of Neighborhood projects must comply with best practices.

Conduct air quality testing at pre-occupancy and after nine months of occupancy to measure levels of Respirable Suspended Particulates (RSP) and Total Volatile Organic Compounds (TVOC).

The project must be designed to include elements that nurture the innate human attraction to natural systems and processes.

No project cannot contain world-class materials or chemicals, such as carcinogens, persistent organic pollutants, bioaccumulative toxins, and endocrine disruptors.

The project must account for the total footprint of embodied carbon (CO_2e) from its construction and projected replacement parts through a one-time carbon offset held project boundary.

The project must advocate for the creation and adoption of third-party certified standards for sustainable resource extraction and fair labor practices. Applicable raw materials include stone and rock, metal, and timber.

The project must incorporate place-based solutions and contribute to the expansion of a regional economy rooted in sustainable practices, products and services.

All projects teams must strive to reduce or eliminate the production of waste during design, construction, operation, and end of life in order to conserve natural resources.

The project must be designed to create human-scaled rather than automobile-scaled places, so that the experience brings out the best in humanity and promotes culture and interaction.

All primary transportation, roads and non-building infrastructure that are externally focused must be equally accessible to all members of the public regardless of background, age and socioeconomic class, with reasonable steps taken to ensure that all people can benefit from the project's creation.

Access for those with physical disabilities must be safeguarded through designs meeting the Americans with Disabilities Act (ADA).

The project may not block access to, nor diminish the quality of, fresh air, sunlight and natural waterways for any member of society or adjacent development.

The project must contain design features intended solely for human delight and the celebration of culture, spirit and place appropriate to its function.

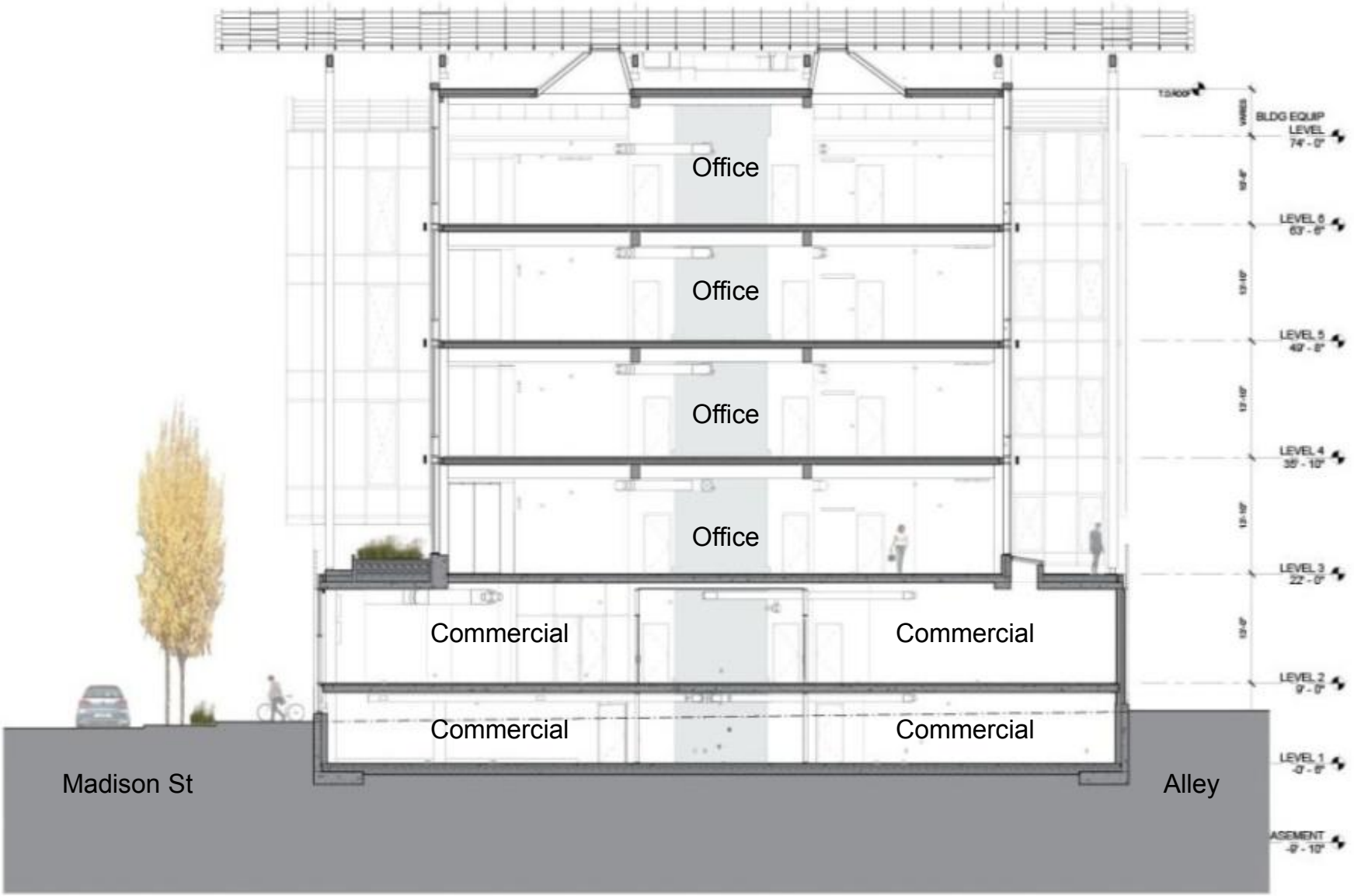
Educational materials about the performance and operation of the project must be provided to the public to share successful solutions and to motivate others to make change.

20 IMPERATIVES

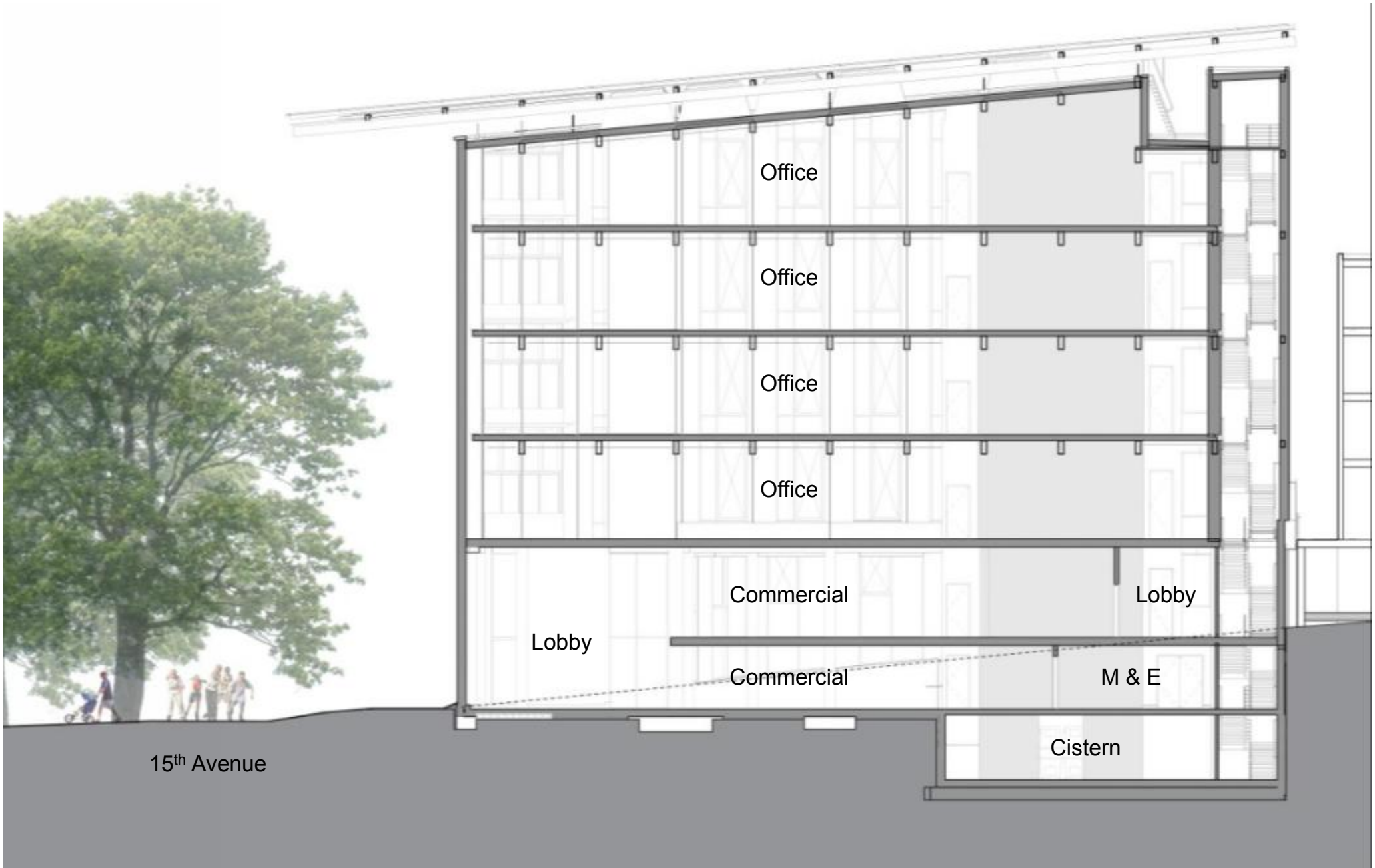

MONTLAKE
SOUTH LAKE UNION
CAPITOL HILL
BELLTOWN
CENTRAL
DISTRICT
DOWNTOWN
INTERNATIONAL
DISTRICT


MADISON ST
15TH AVE
MCGILVRA PLACE
E PIKE ST
4-STORY
EXIST BLDG


GREEN ROOF
OFFICE
TENANT
TERRACE



Courtesy: Miller Hull

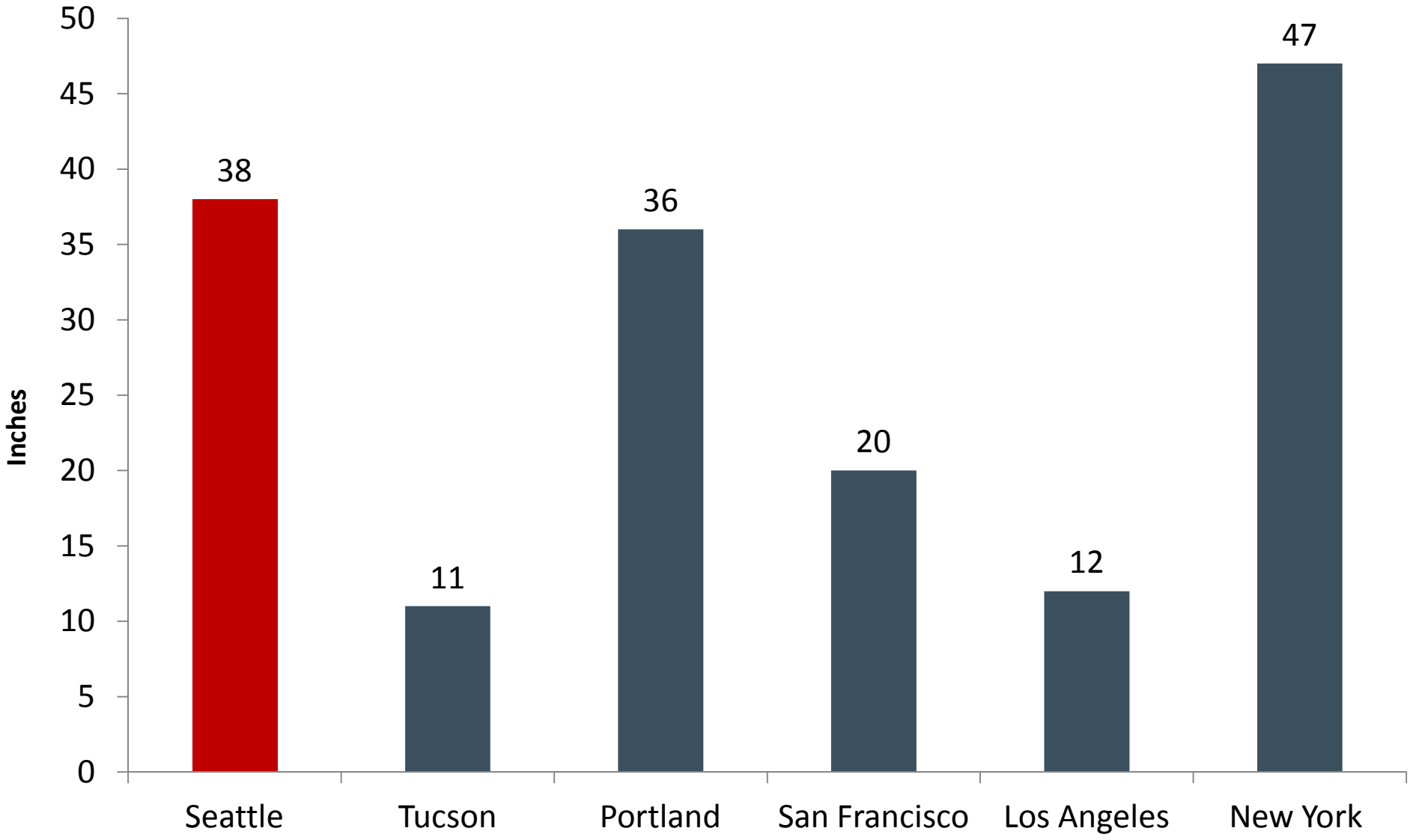

Office
Office
Office
Office
Commercial
Lobby
Lobby
Commercial
M & E
Cistern
15th Avenue

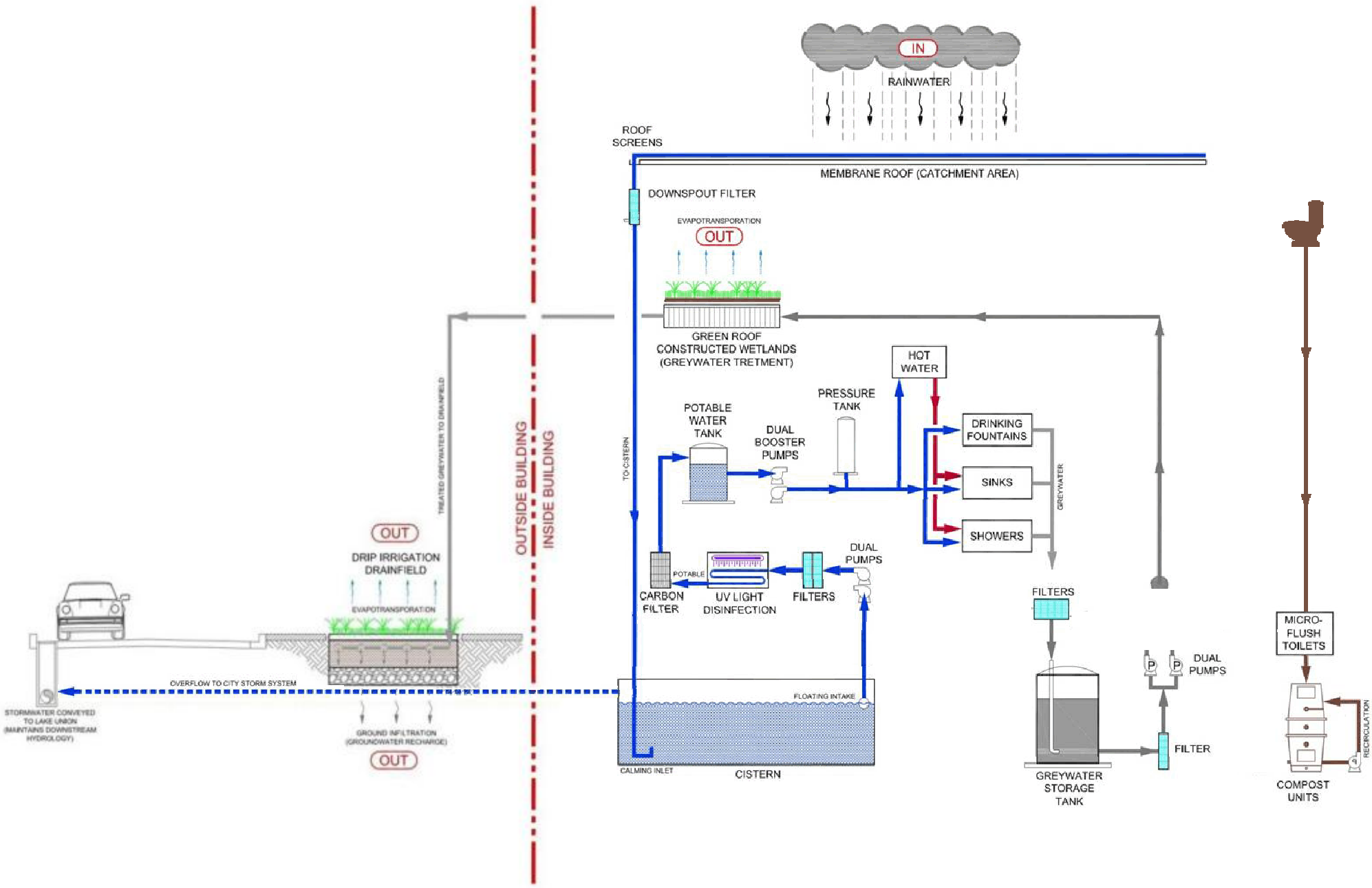
NET-ZERO WATER

RAINWATER CAPTURE AND
ON-SITE WASTE WATER TREATMENT

Net Zero Water

Rain Income – Average Yearly Rain Fall

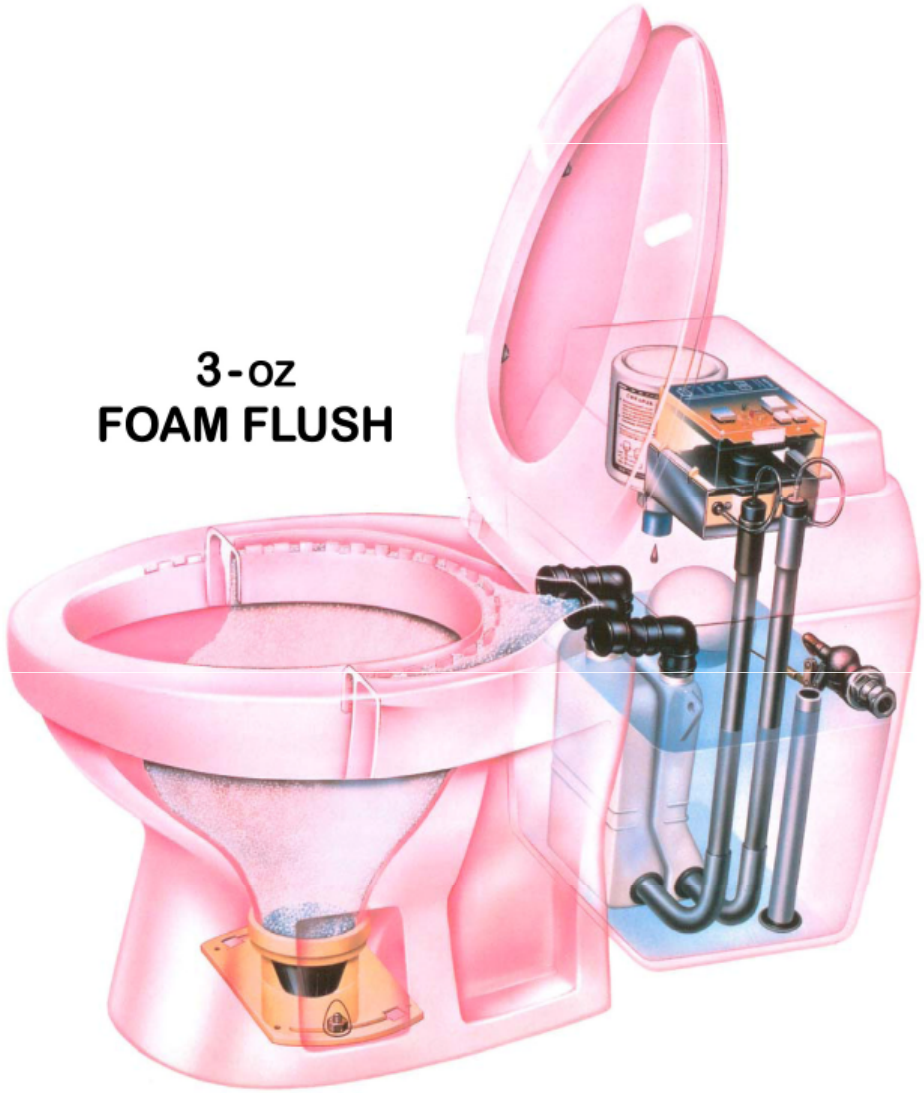




Courtesy: 2020 Engineering

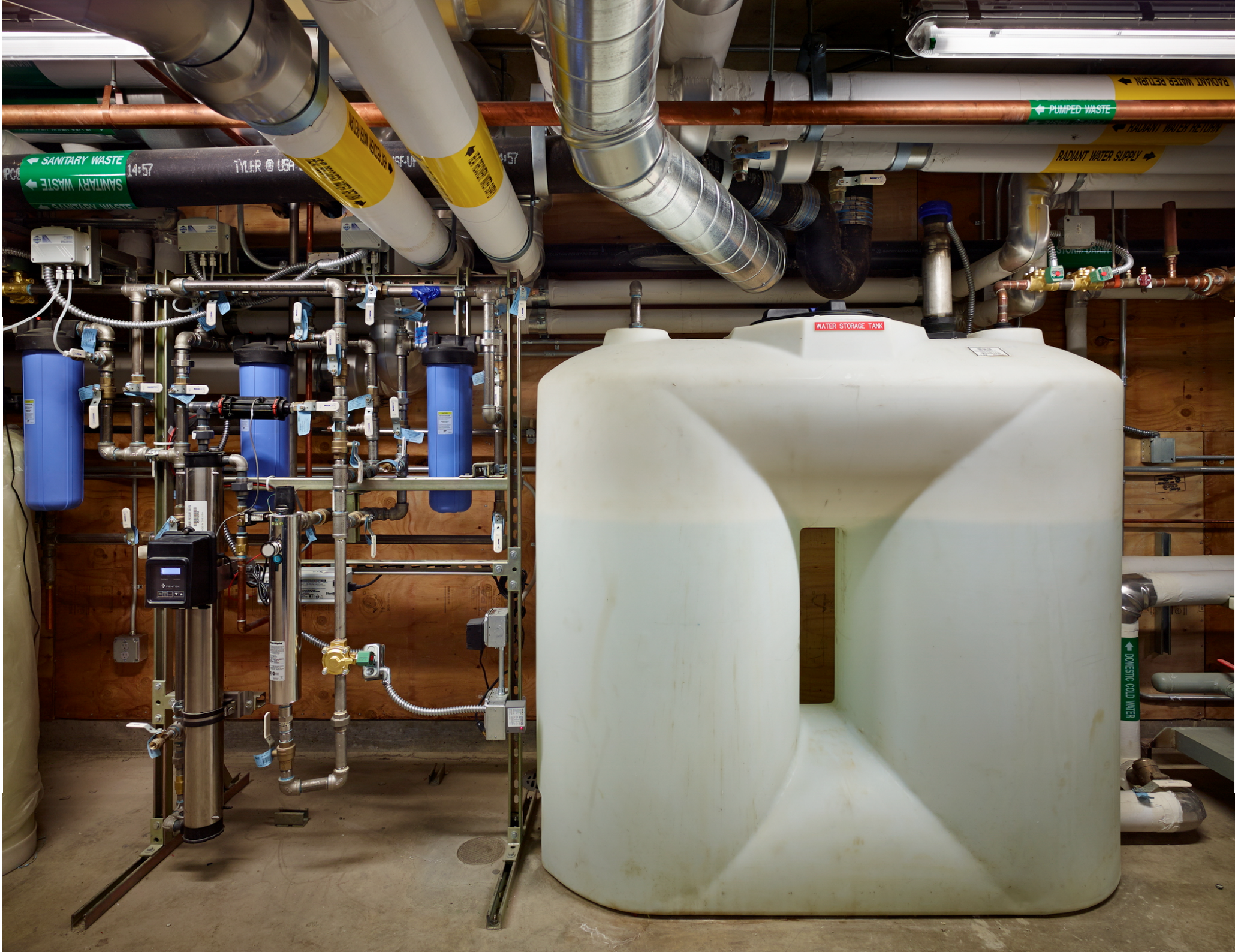
Net Zero Water

Foam Flush Toilets



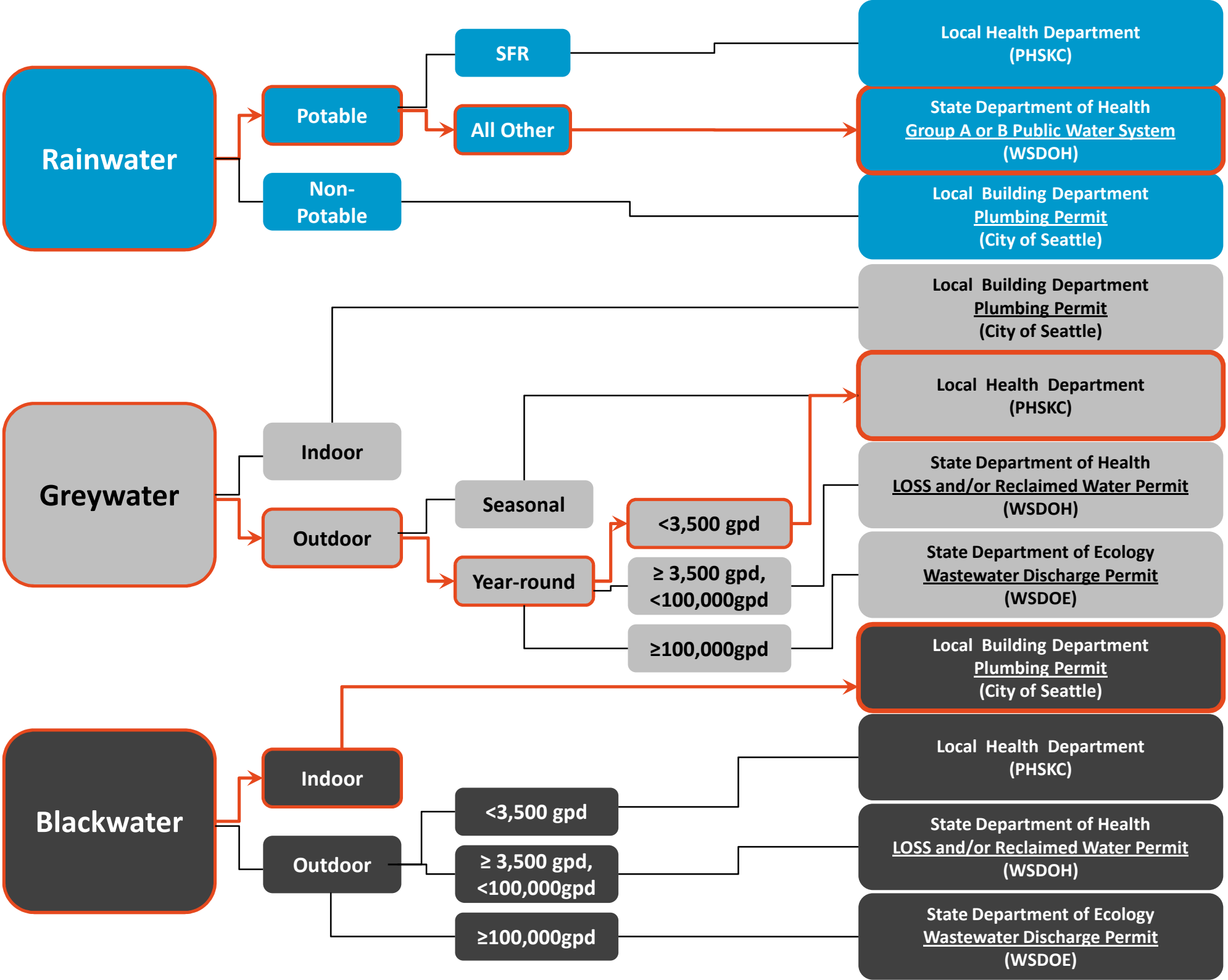

SANITARY WASTE


CONDENSATE DRAIN
SANITARY


SANITARY WASTE
PUMPED WASTE
RADIANT WATER RETURN
RADIANT WATER SUPPLY
WATER STORAGE TANK
DOMESTIC COLD WATER

GRAY WATER TREATMENT

IMAGE: MILLER HULL

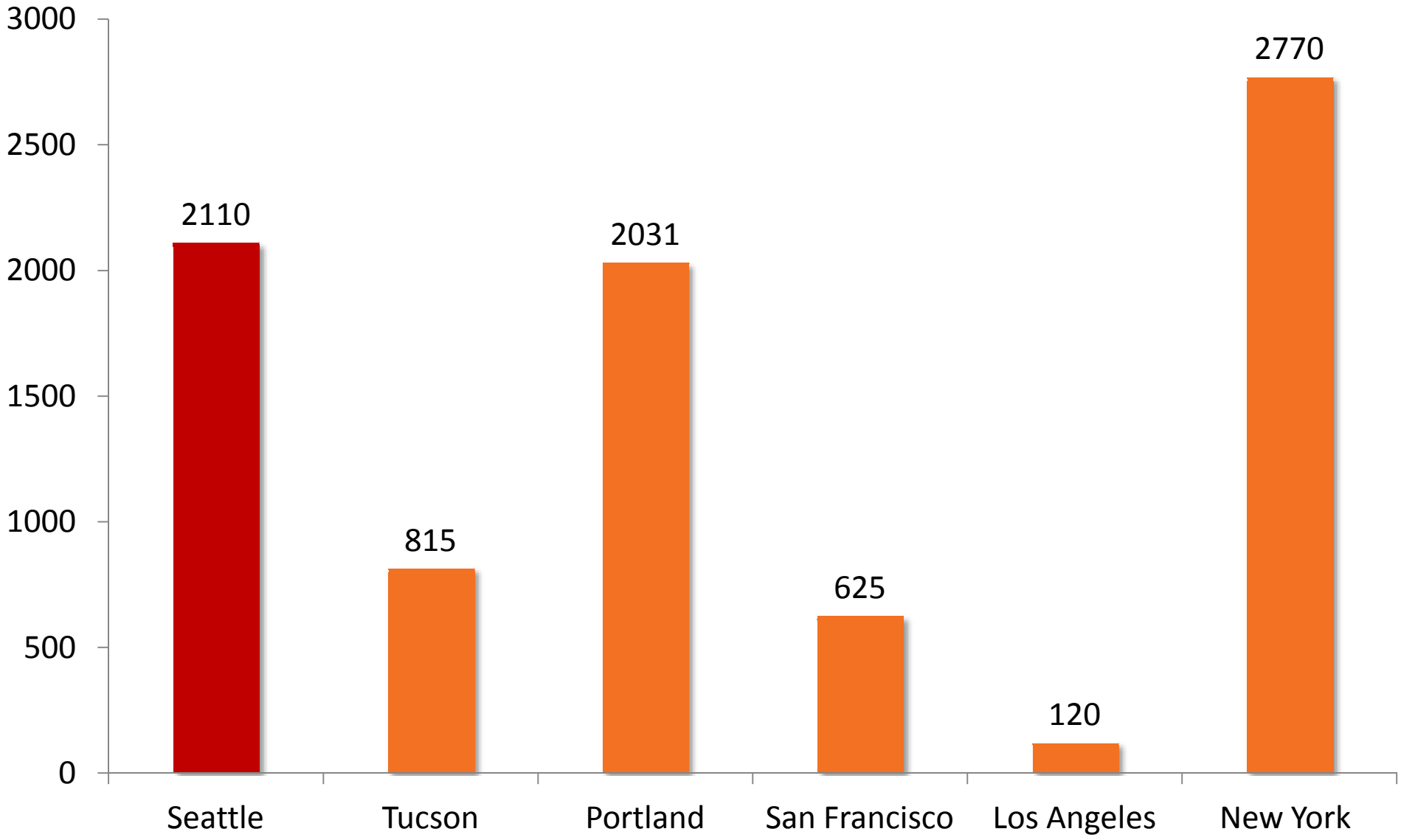

Rainwater
Potable
Non-Potable
SFR
All Other
Local Health Department (PHSKC)
State Department of Health Group A or B Public Water System (WSDOH)
Local Building Department Plumbing Permit (City of Seattle)
Greywater
Indoor
Outdoor
Seasonal
Year-round
<3,500 gpd
≥ 3,500 gpd, <100,000gpd
≥100,000gpd
Local Building Department Plumbing Permit (City of Seattle)
Local Health Department (PHSKC)
State Department of Health LOSS and/or Reclaimed Water Permit (WSDOH)
State Department of Ecology Wastewater Discharge Permit (WSDOE)
Blackwater
Indoor
Outdoor
<3,500 gpd
≥ 3,500 gpd, <100,000gpd
≥100,000gpd
Local Building Department Plumbing Permit (City of Seattle)
Local Health Department (PHSKC)
State Department of Health LOSS and/or Reclaimed Water Permit (WSDOH)
State Department of Ecology Wastewater Discharge Permit (WSDOE)

NET-ZERO ENERGY

ACHIEVING ENERGY INDEPENDENCE

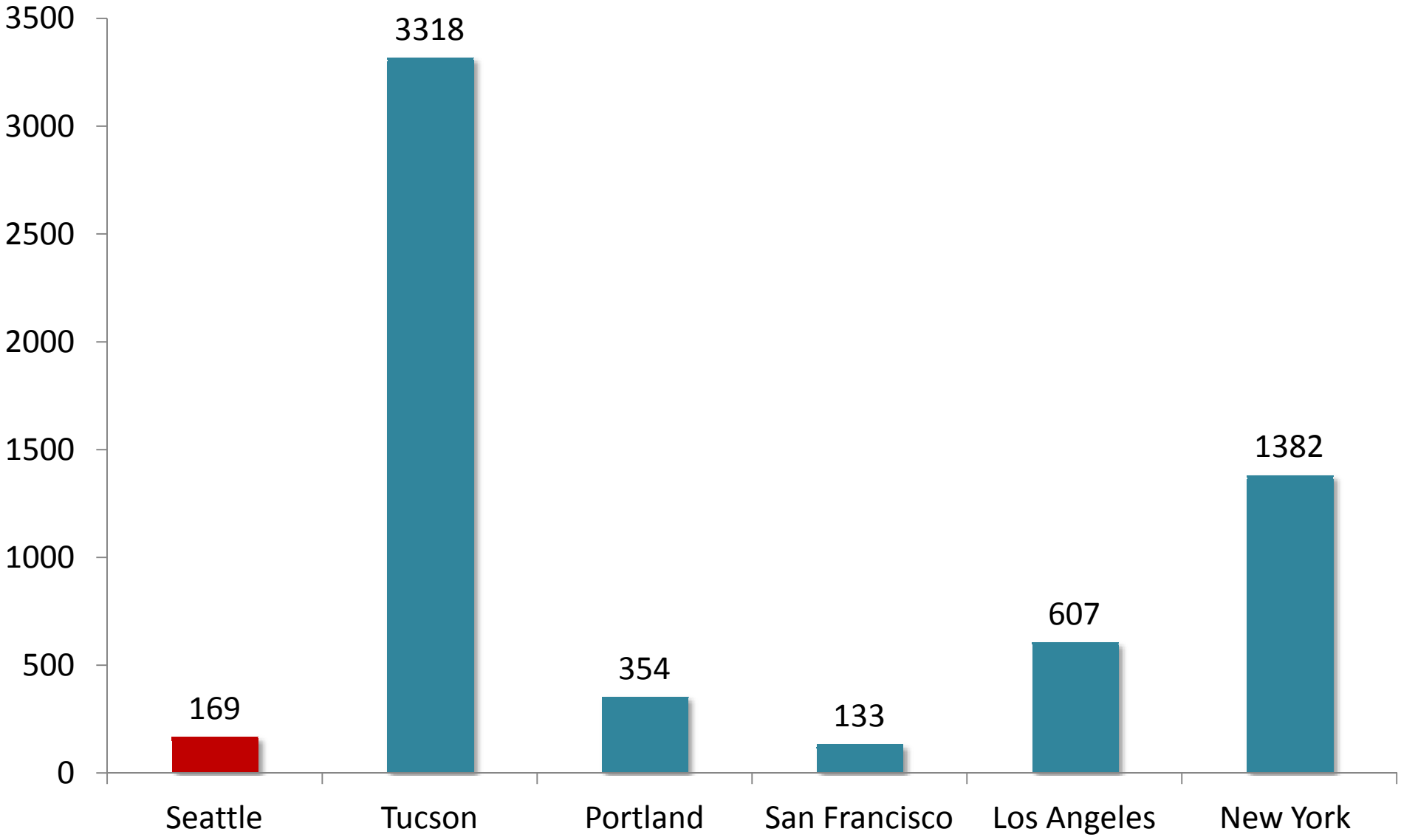
Climate

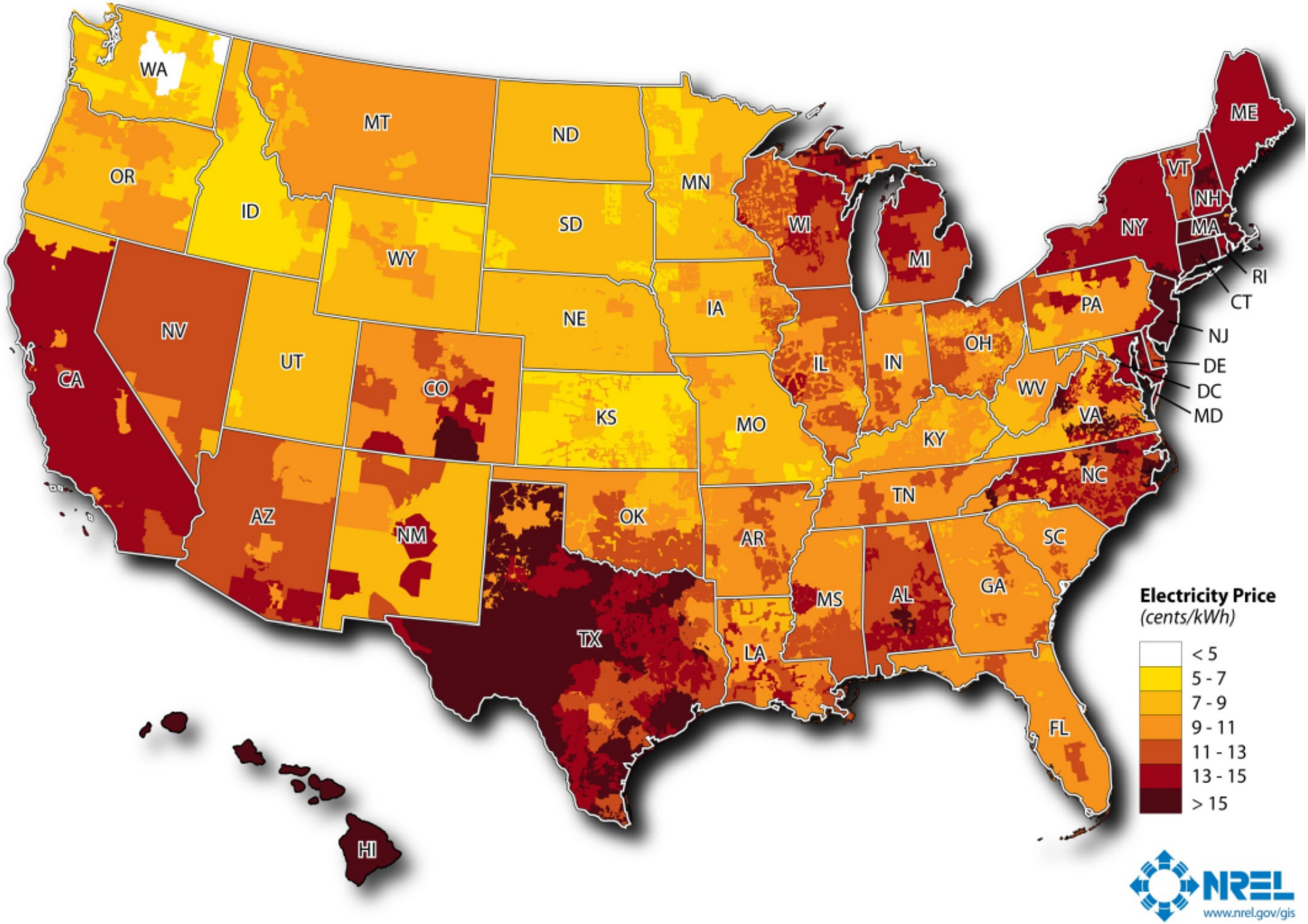
Heating Degree Days



Climate

Cooling Degree Days

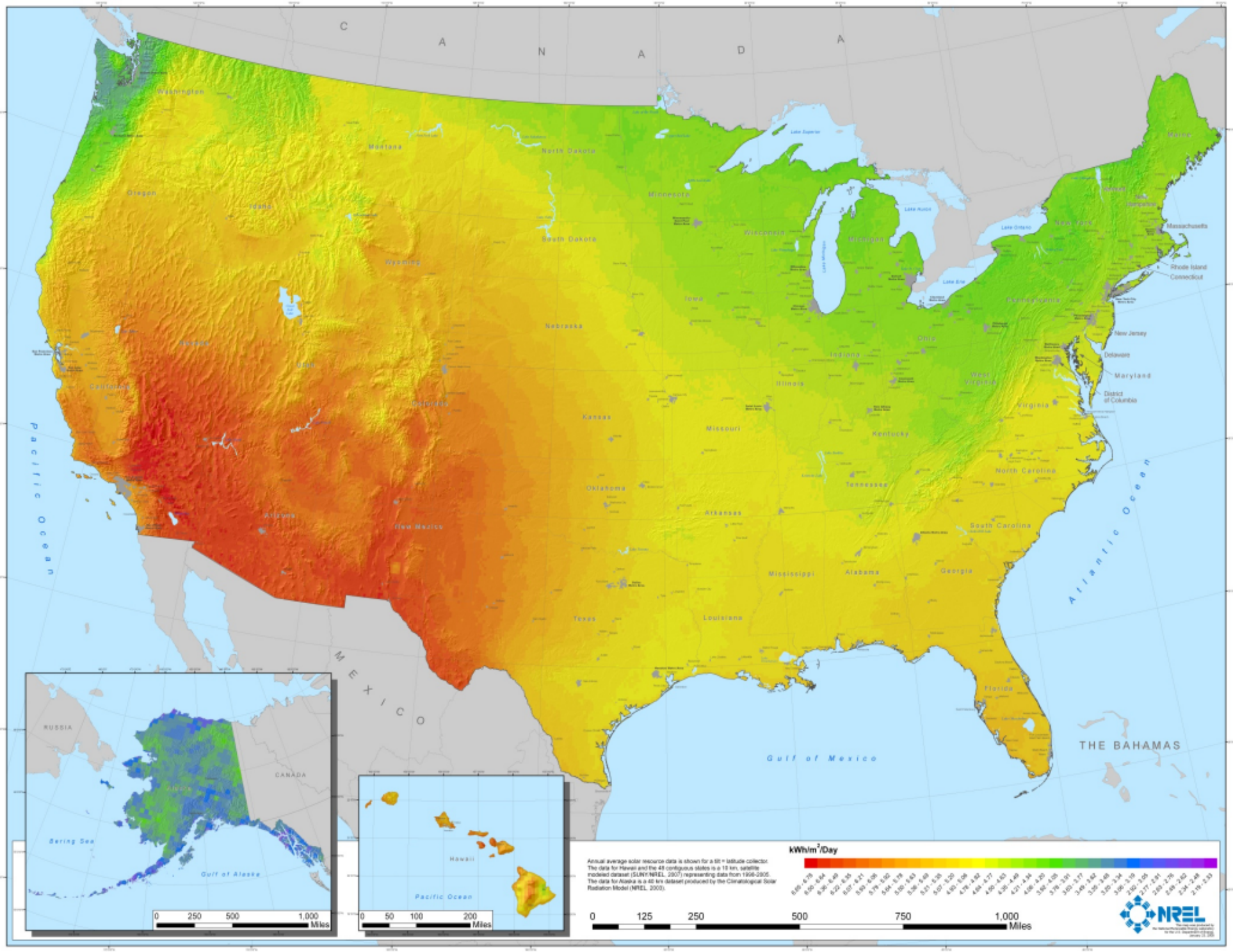




Author : Billy Roberts - March 30, 2010

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.

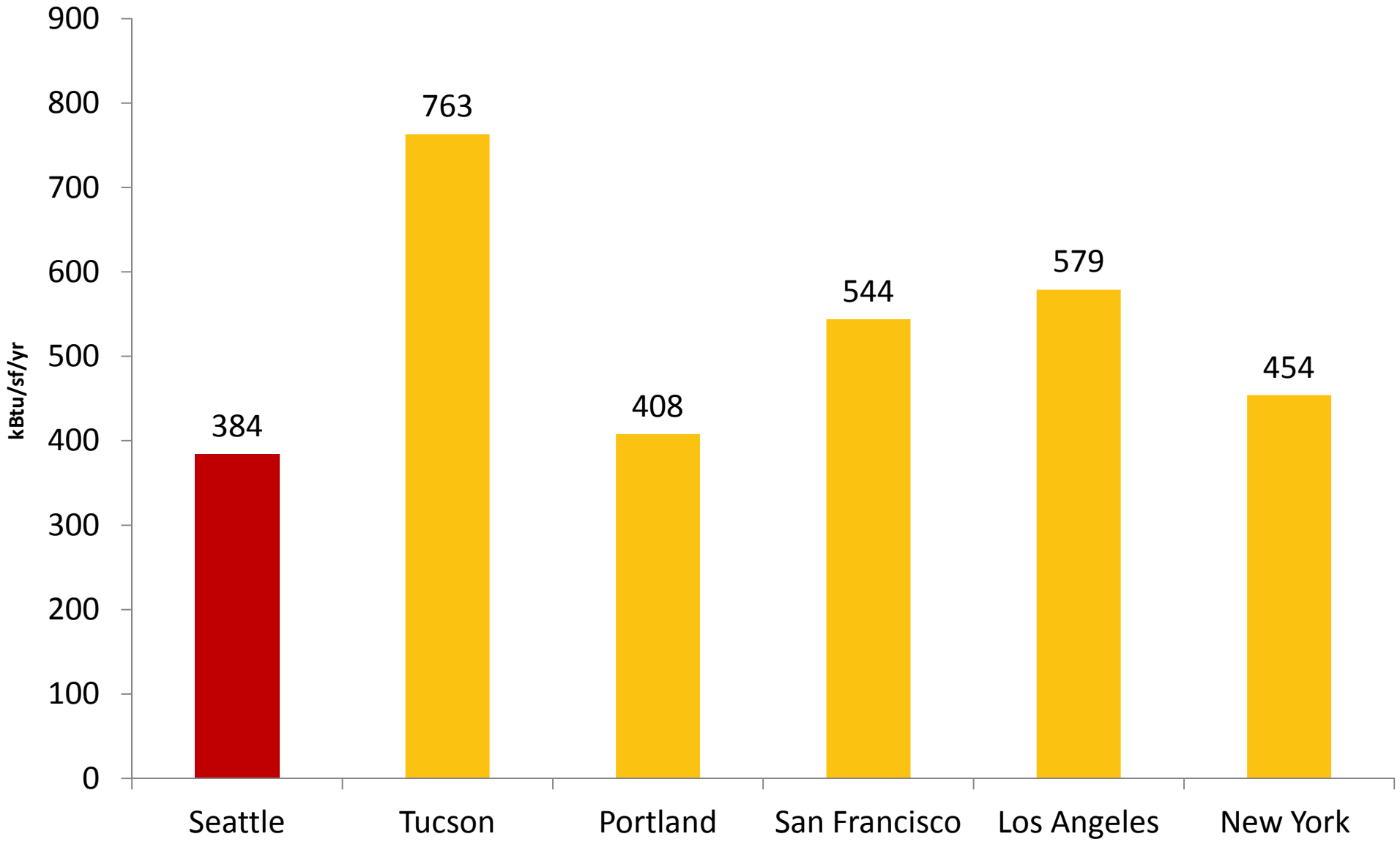
United States Photovoltaic Solar Resource : Flat Plate Tilted at Latitude



Annual average solar resource data is shown for a tilt = latitude collector. The data for Hawaii and the 48 contiguous states is a 10 km, satellite modeled dataset (SUNY/NREL, 2007) representing data from 1998-2005. The data for Alaska is a 40 km dataset produced by the Climatological Solar Radiation Model (NREL, 2003).

Climate

Solar Income



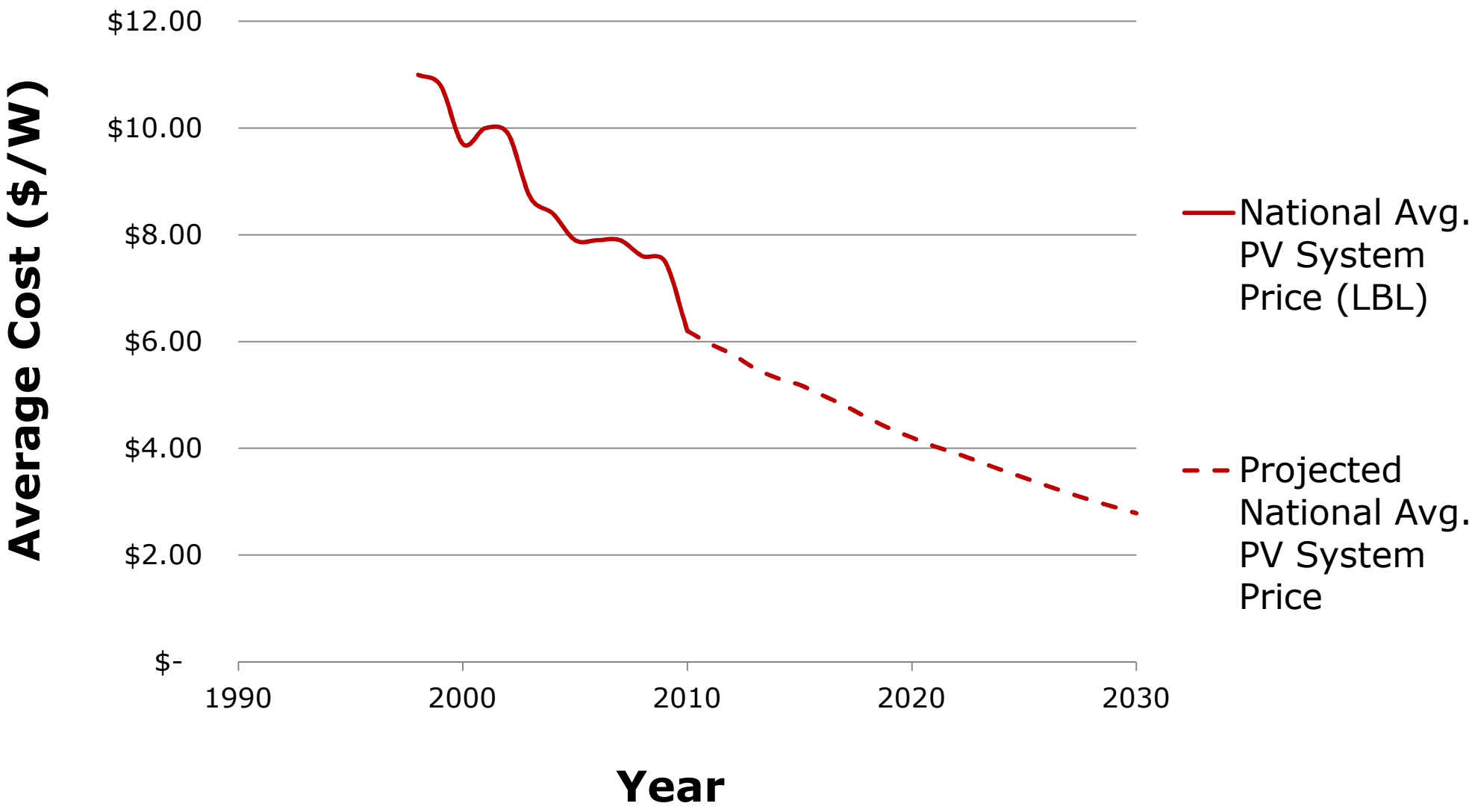
Net Zero Energy

Sunpower 425W - SPR-425E-WHT-D

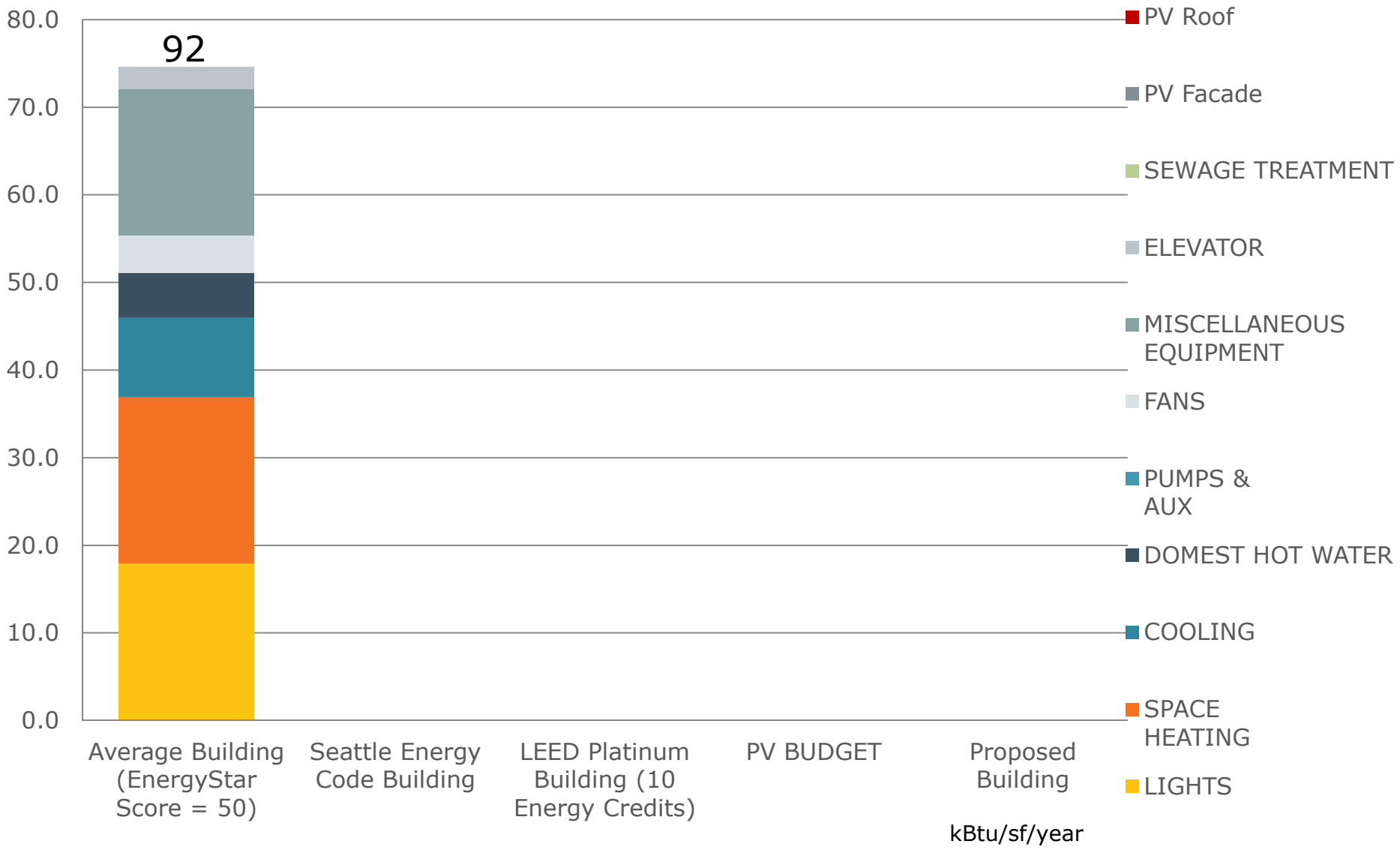
Number of modules	570
Unit Nom. Power	425 W
Peak System Output	227 kW
Produced Energy	242,000 KWH/yr
Panel Efficiency (STC)	19.7%
System Efficiency	~16%

First cost trend

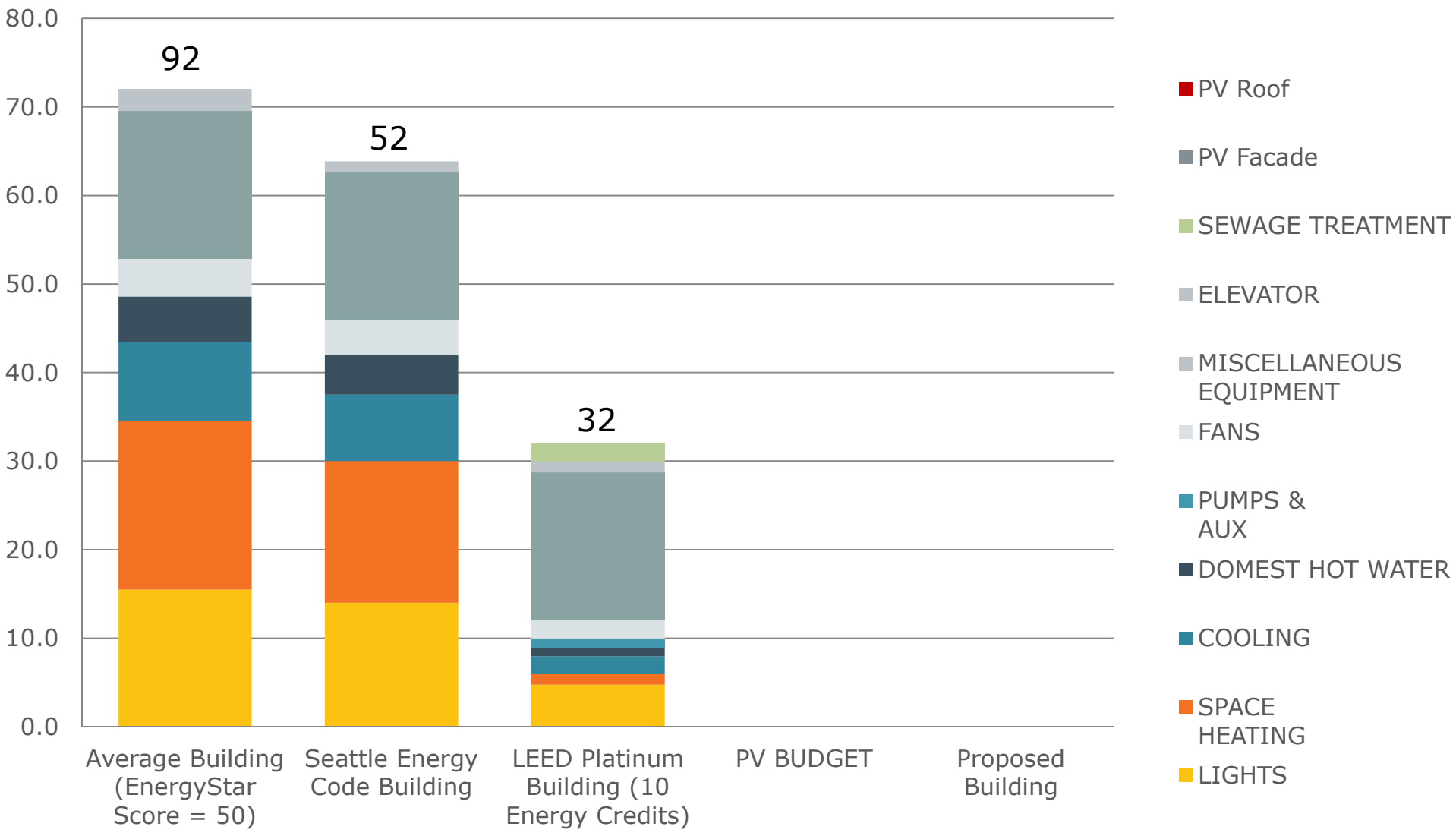
Average Price of PV



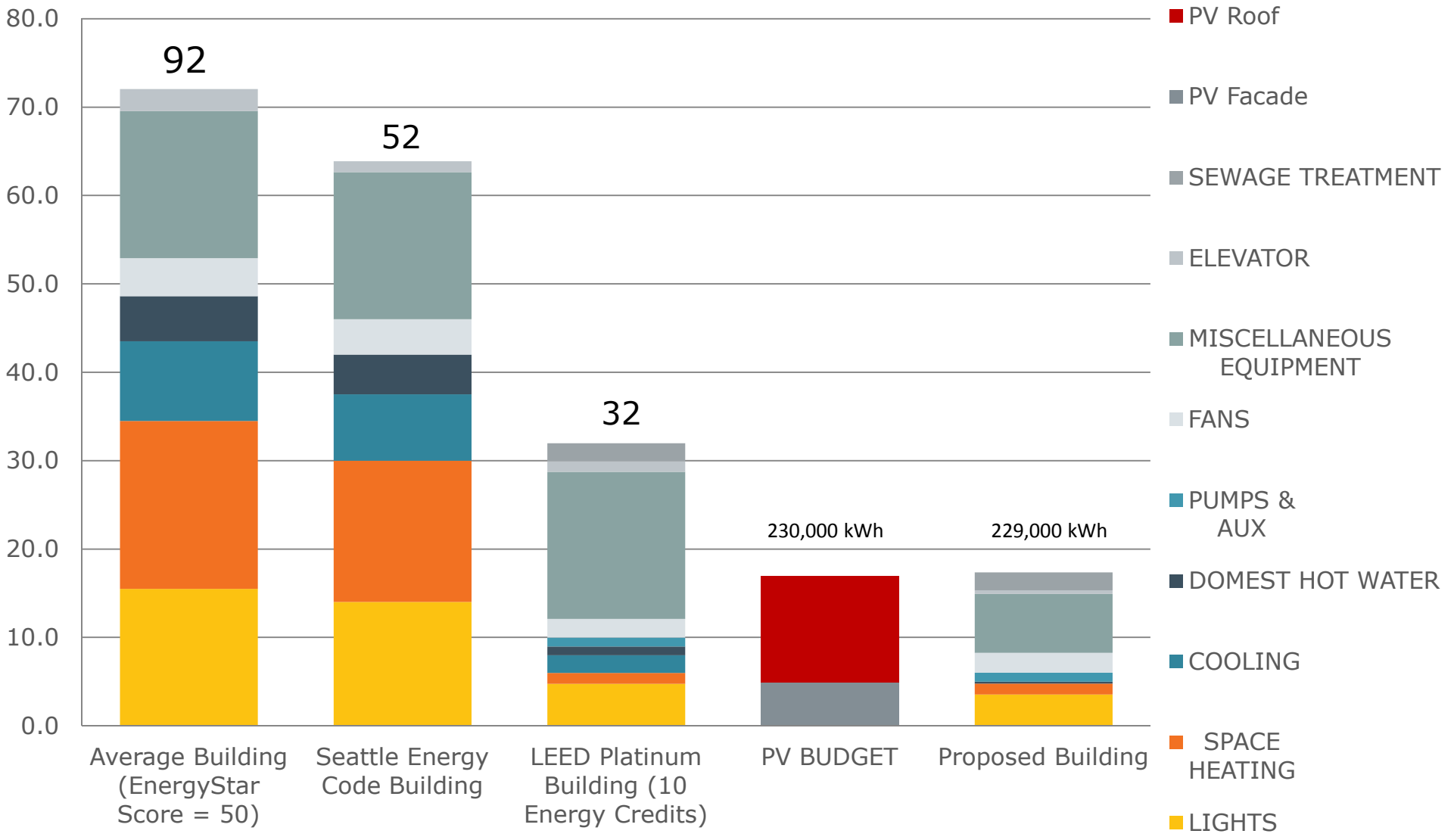
Energy Use + Solar Budget



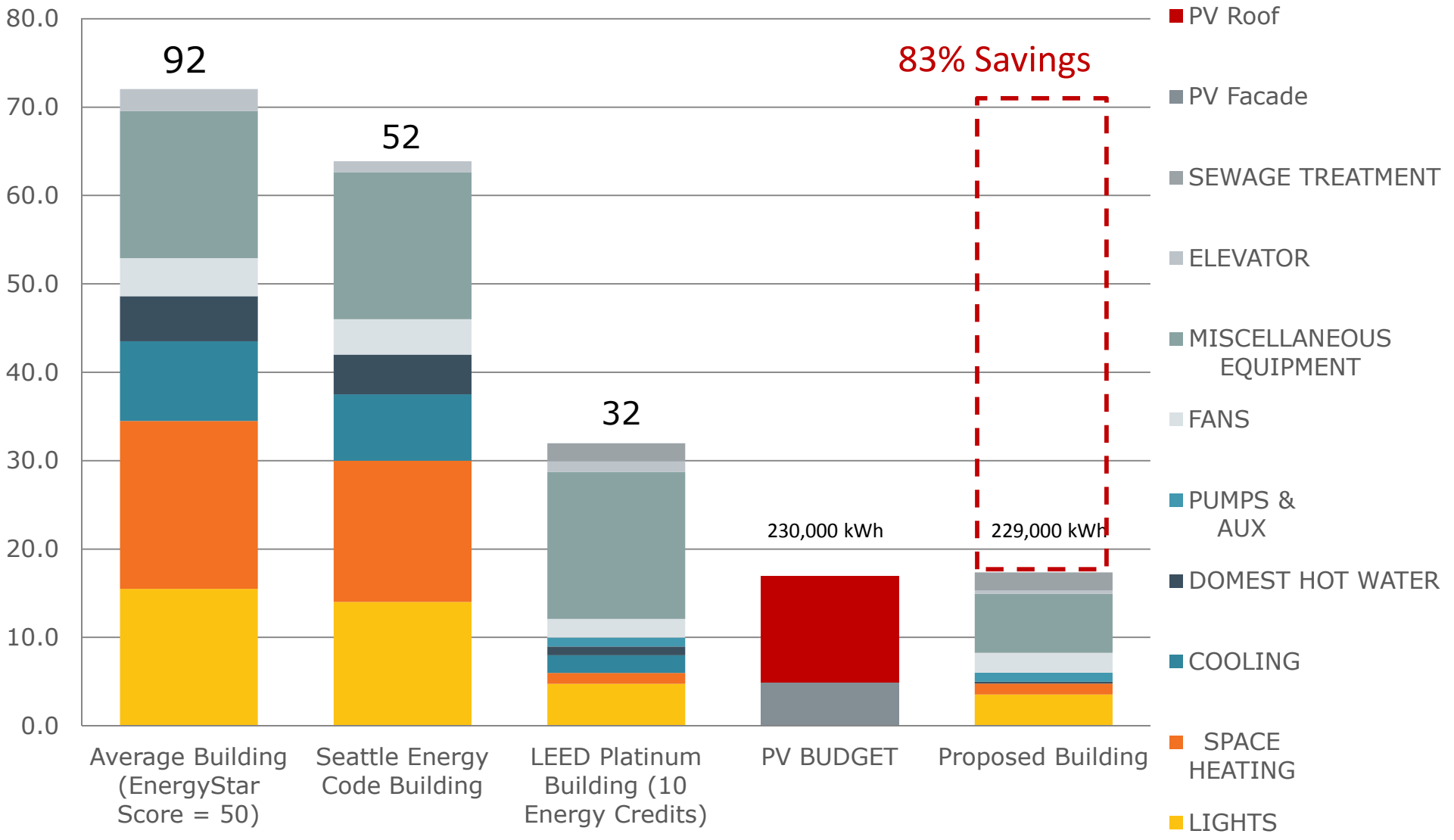
Energy Use + Solar Budget



Energy Use + Solar Budget

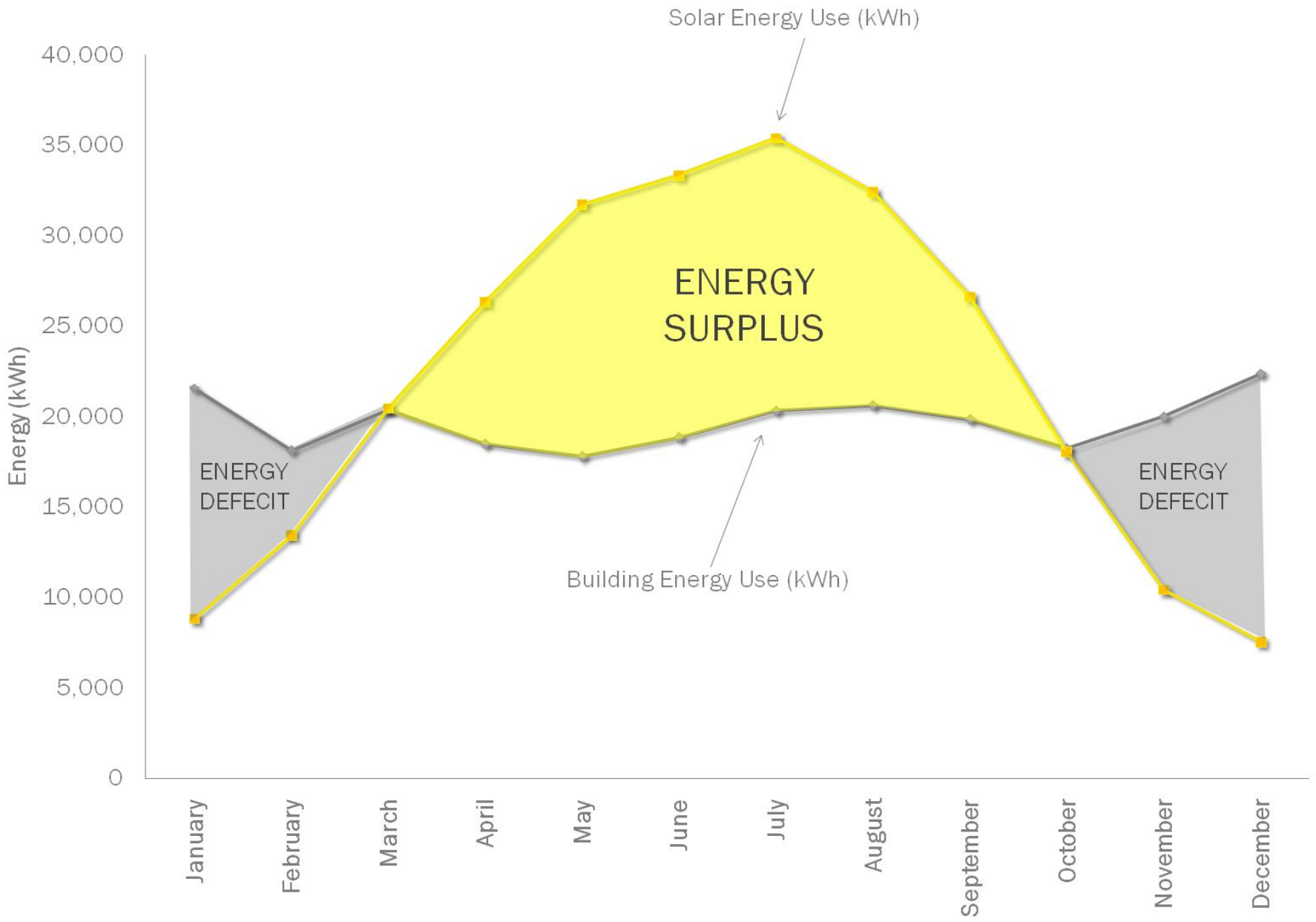


Energy Use + Solar Budget



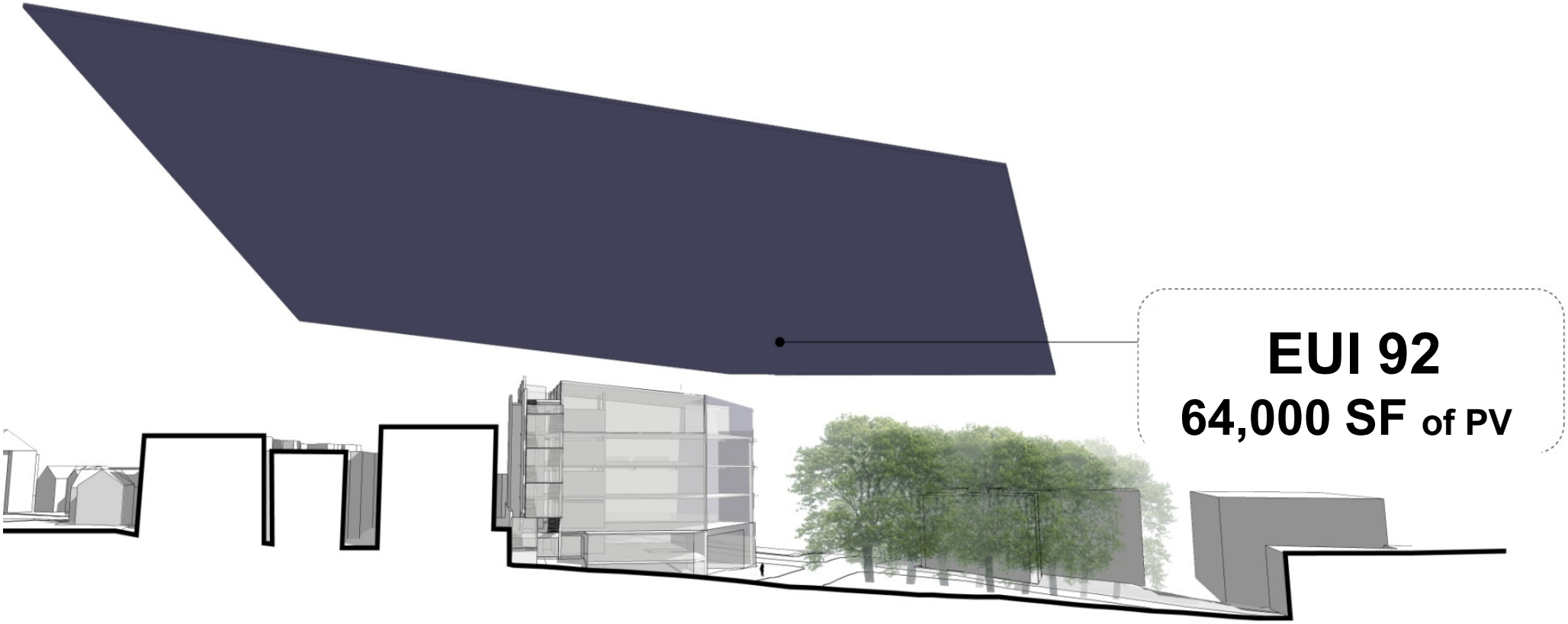
Net Zero Energy

Energy Use | Solar Budget



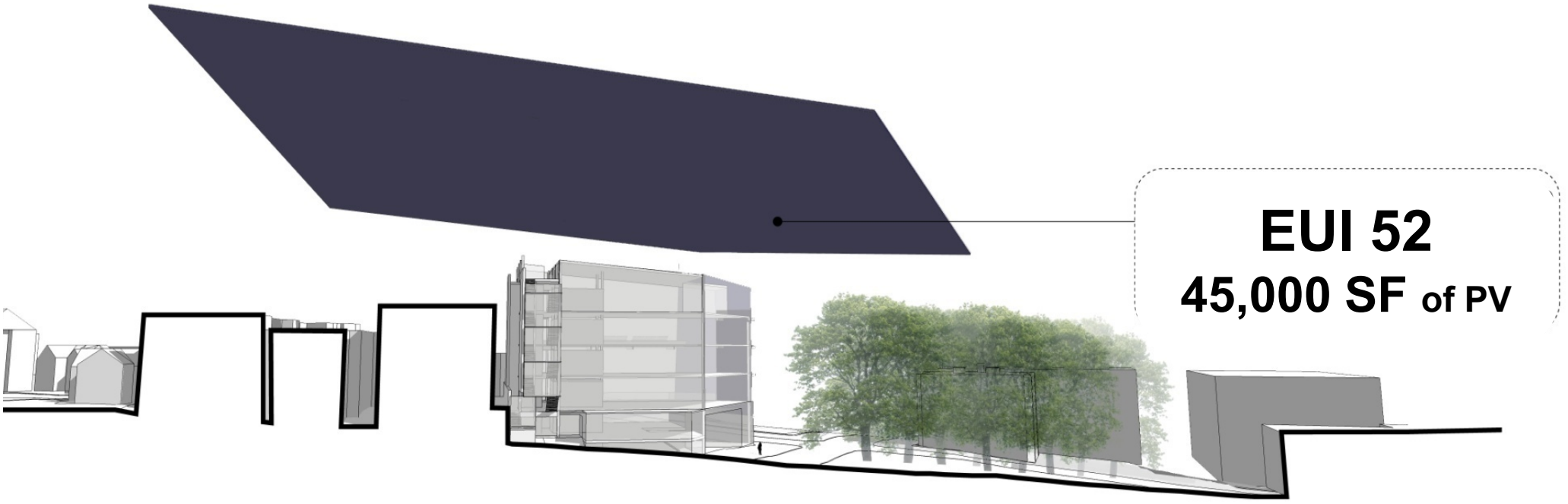
Net Zero Energy

PV Area



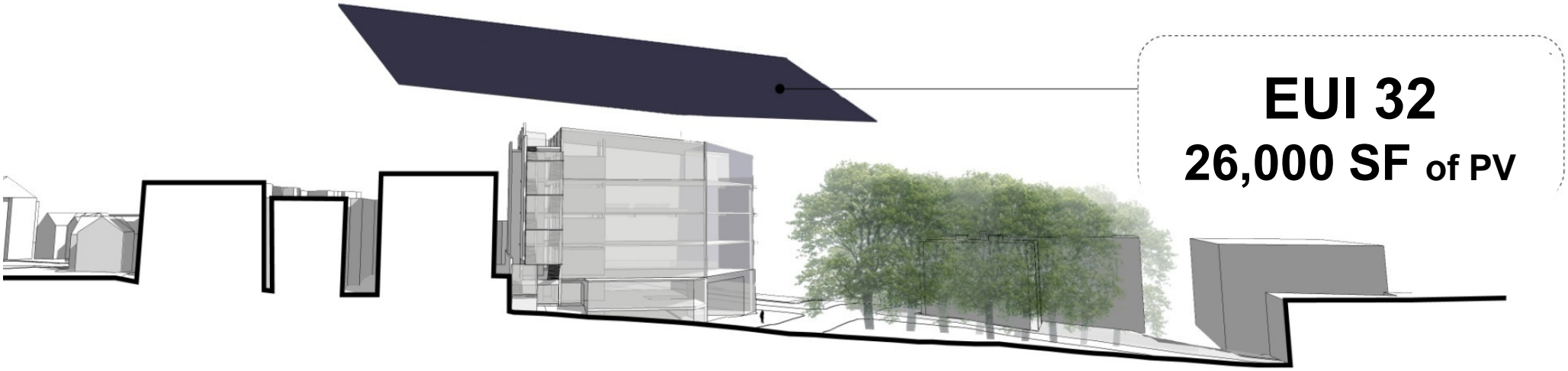
Net Zero Energy

PV Area



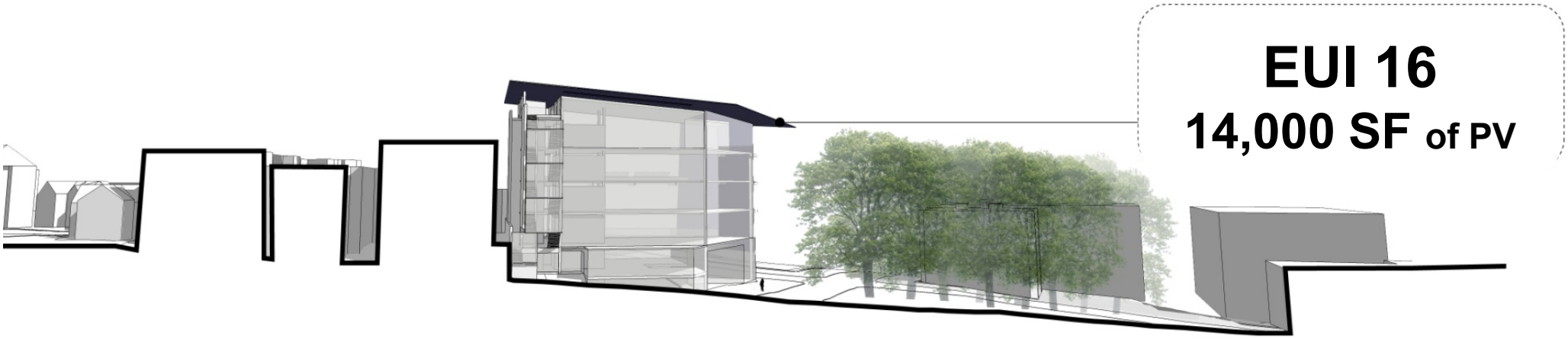
Net Zero Energy

PV Area



Net Zero Energy

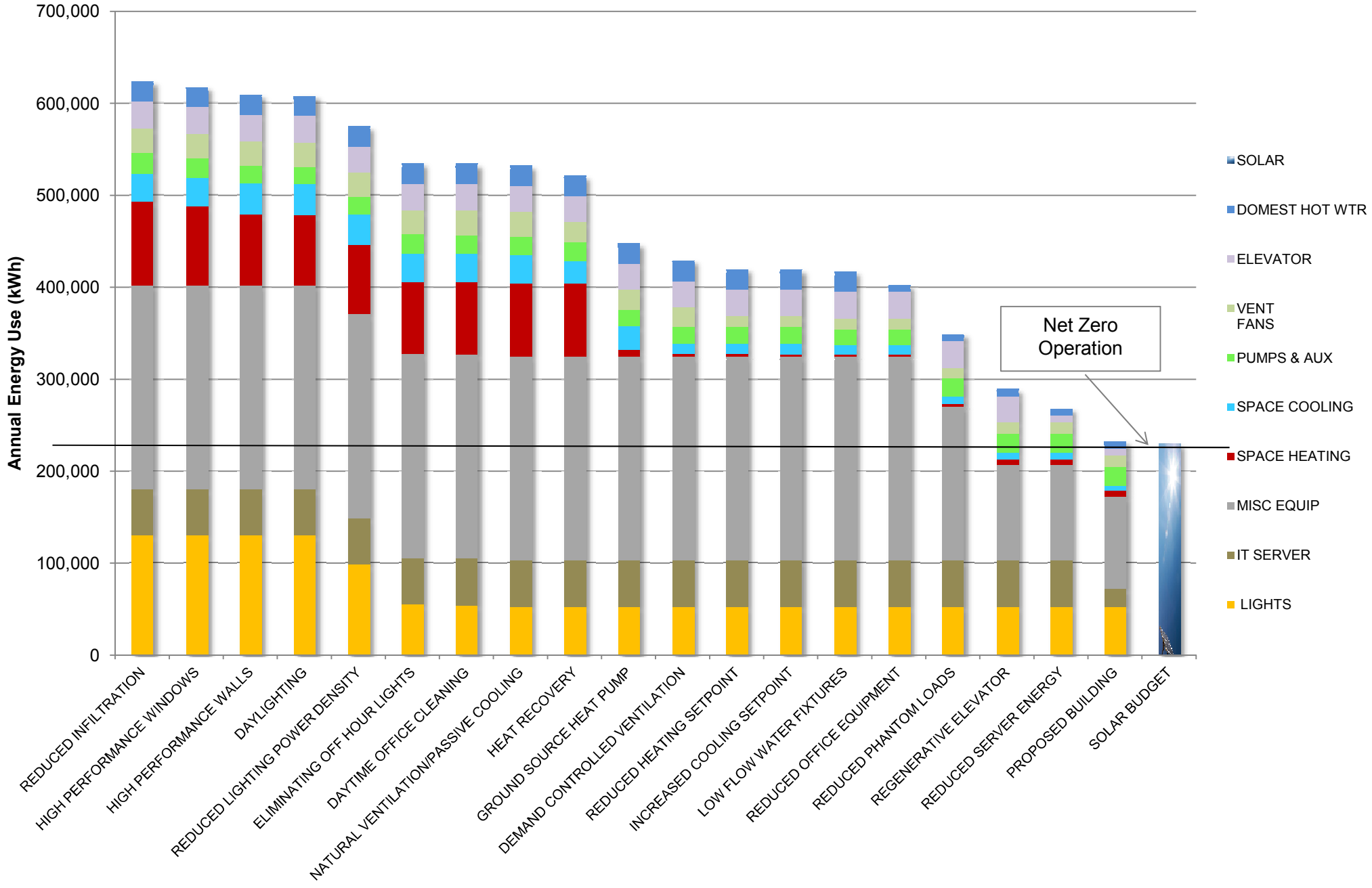
PV Area



EUI 16

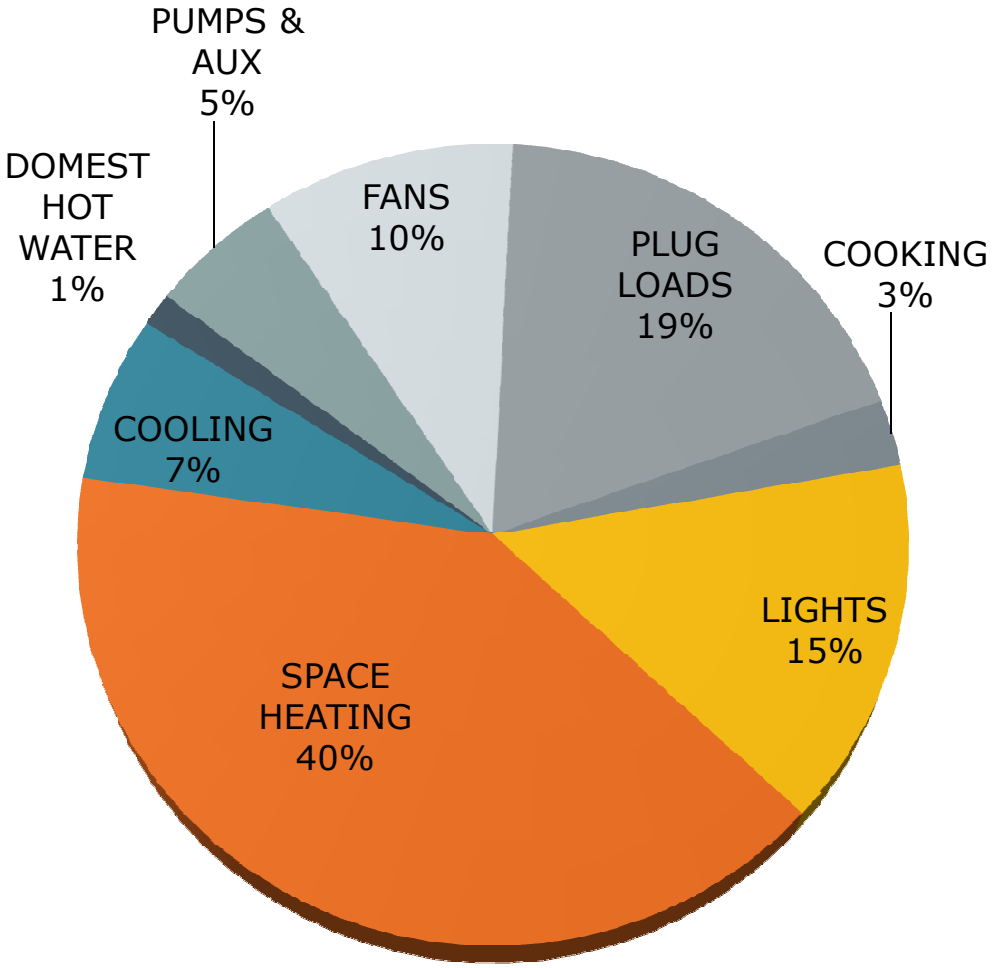
14,000 SF of PV

Energy Efficiency Measures

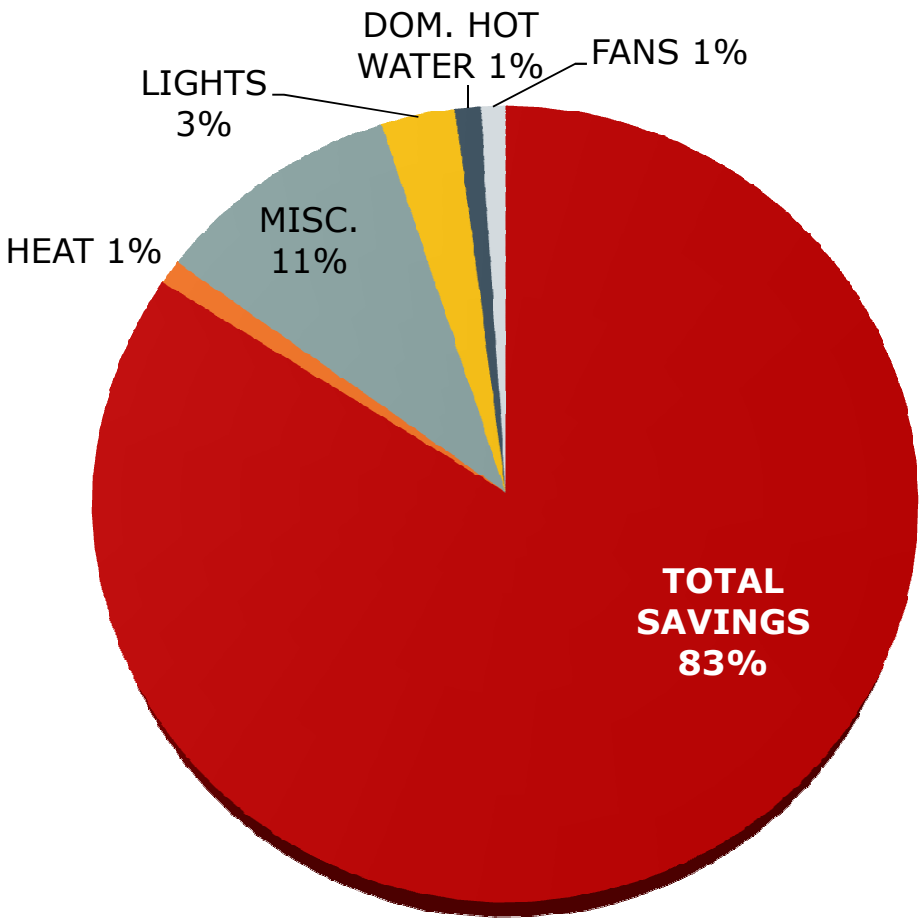


Net Zero Energy

Energy Consumption



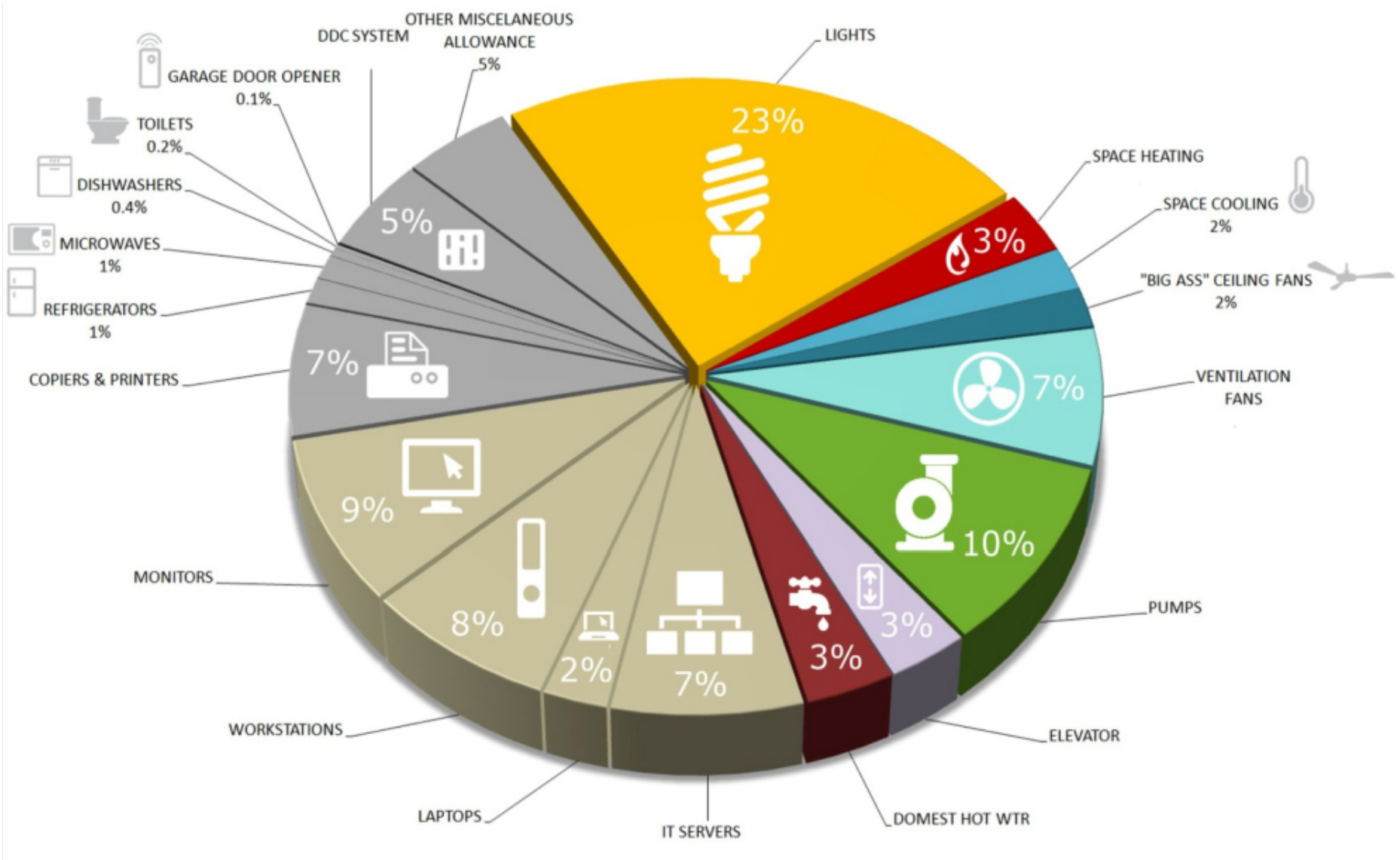
Typical Building



Proposed Building

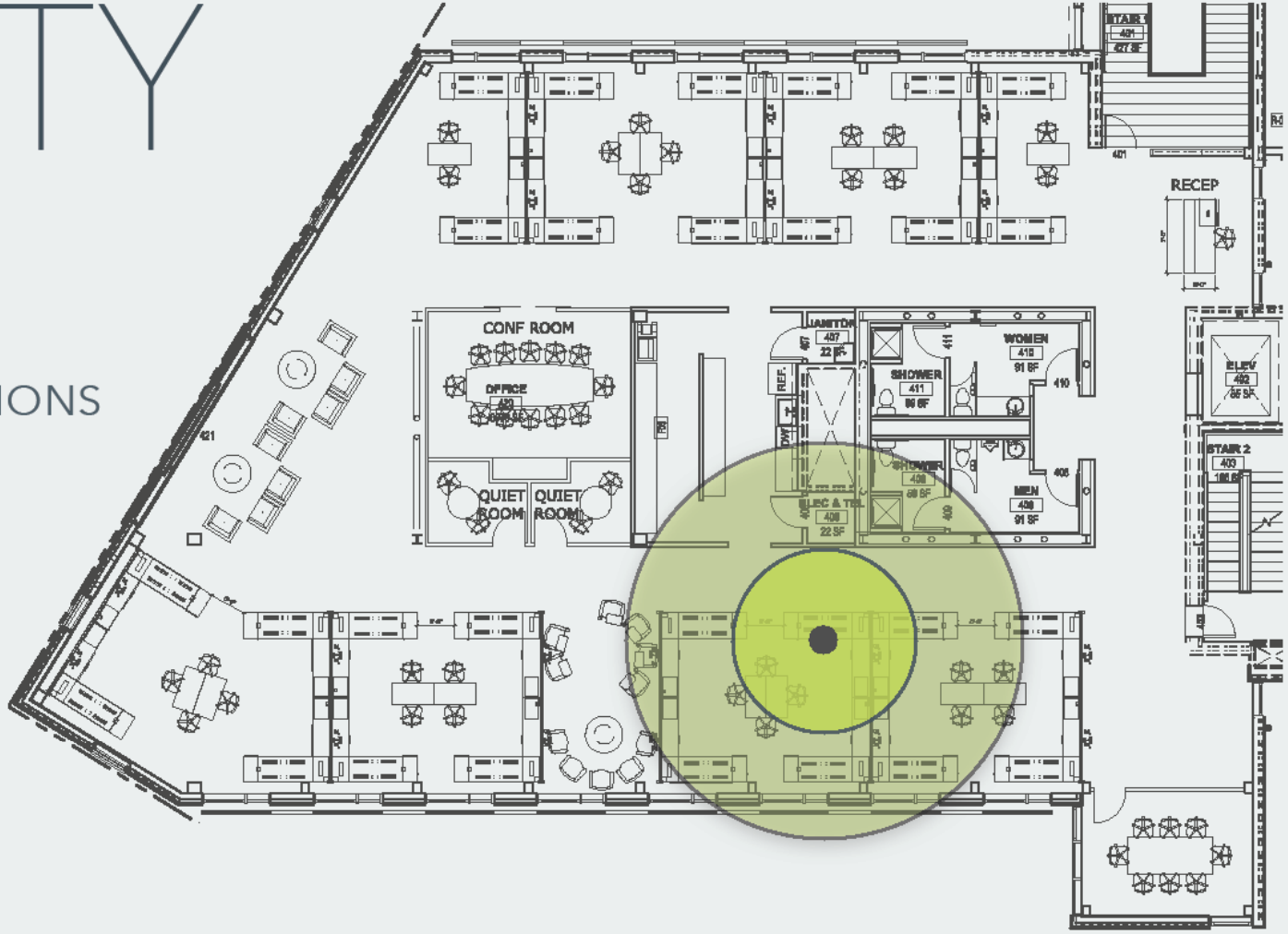
Net Zero Energy

Proposed Building Energy Use



EQUITY

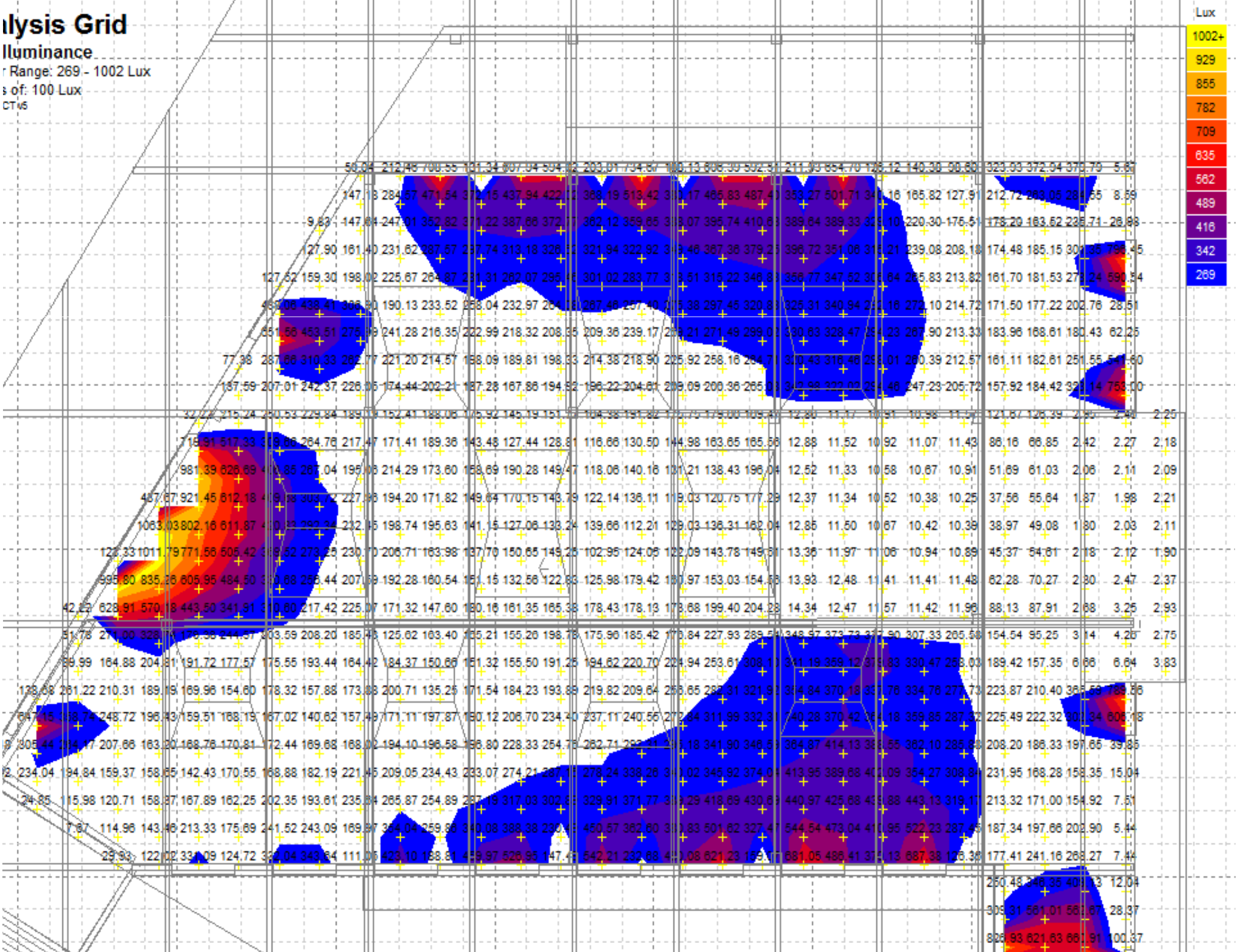
ALL PRIMARY WORKSTATIONS ARE WITHIN 30’-0” OF OPERABLE WINDOWS.

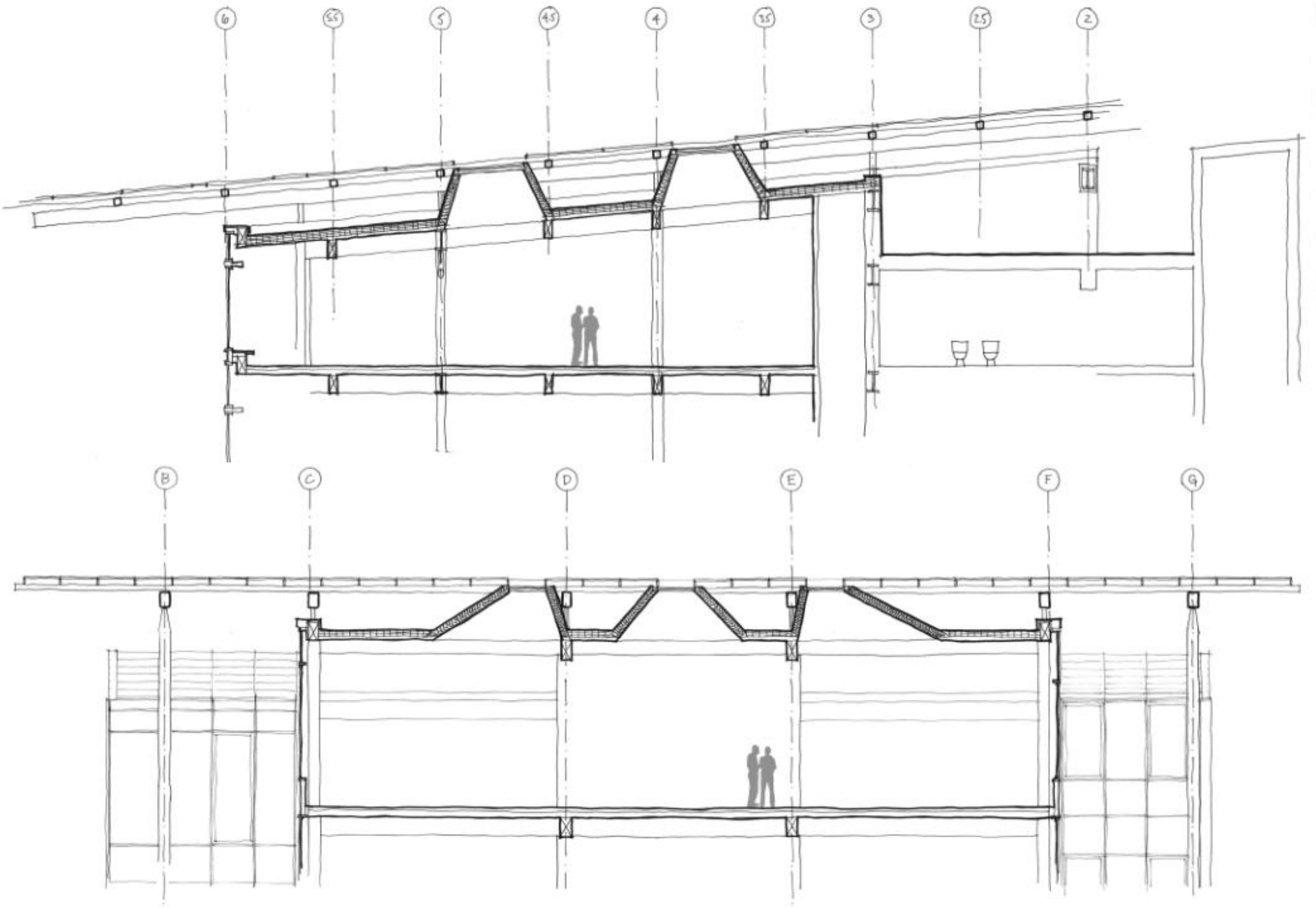


AUTOMATED OPERABLE WINDOWS

4’-0” X 10’-0” WINDOWS PROVIDED FRESH AIR TO TENANTS


Glasroc H
Glasroc H
Glasroc H


lysis Grid
lluminance
Range: 269 - 1002 Lux
s of: 100 Lux
CTv5
Lux
1002+
929
855
782
709
635
562
489
416
342
269


6
5.5
5
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4
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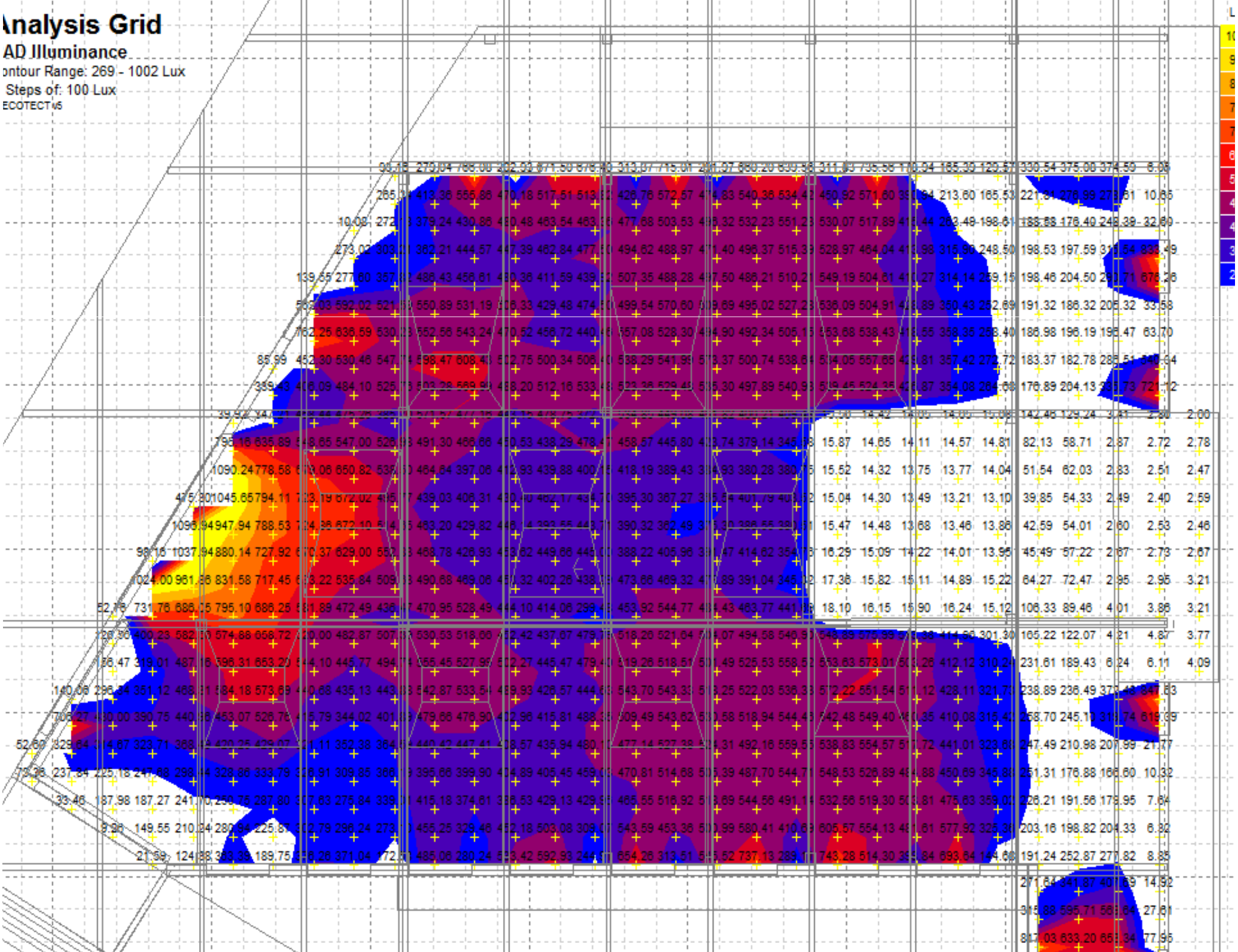
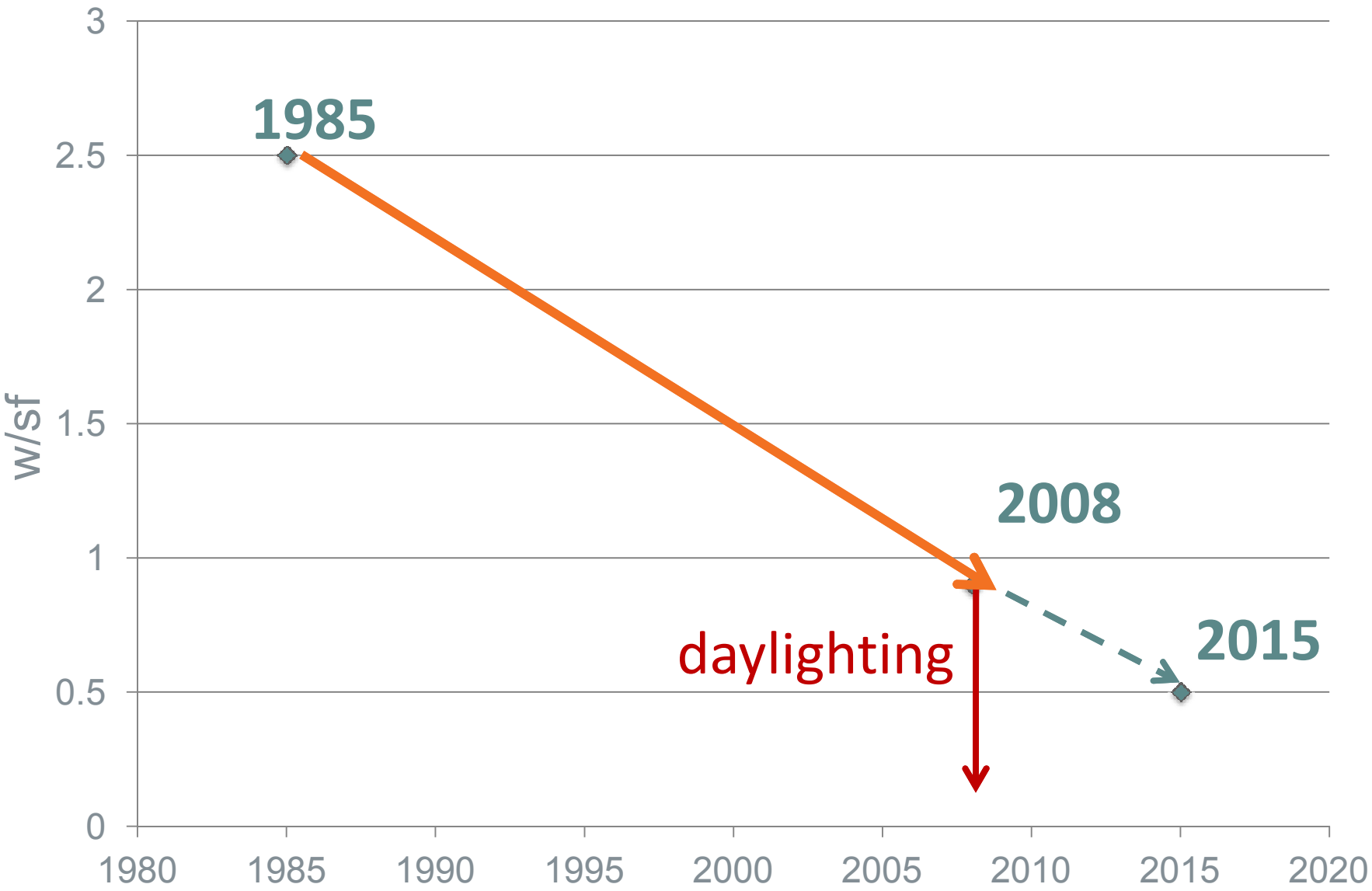
G


Analysis Grid
AD Illuminance
ontour Range: 269 - 1002 Lux
Steps of: 100 Lux
ECOTECT v5

Net Zero Energy - Lighting

Lighting Codes



Net Zero Energy - Lighting

Dynamic Solar Shading & Glare Control

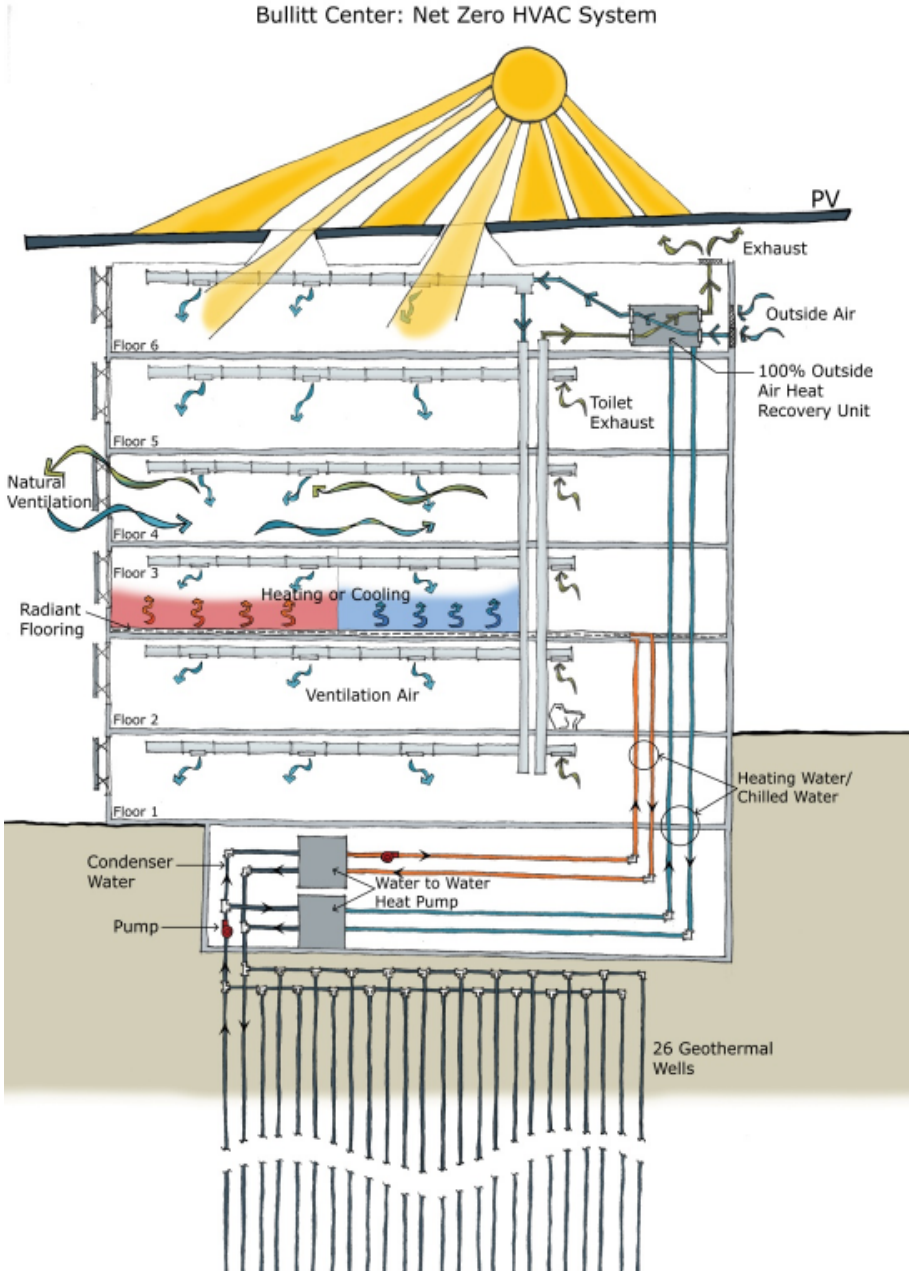
Net Zero Energy - Envelope

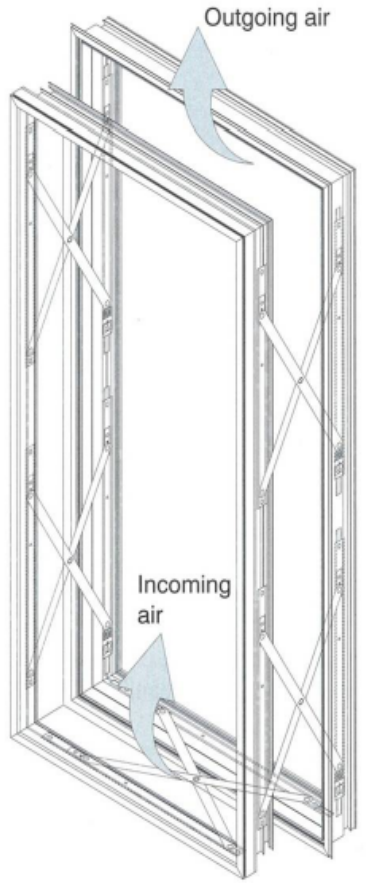
Goals

Envelope	Seattle Code	Bullitt Foundation
Roof	R-29	R-38
Wall	R-16	R-21.4
Glazing	R-2	R-4 VT = 0.53
Infiltration	0.40 cfm/sf (New)	.24 cfm/sf

Net Zero Energy - HVAC

System Overview





Occupants

Lease Requirements

Energy Requirements

Water Requirements

Materials Requirements

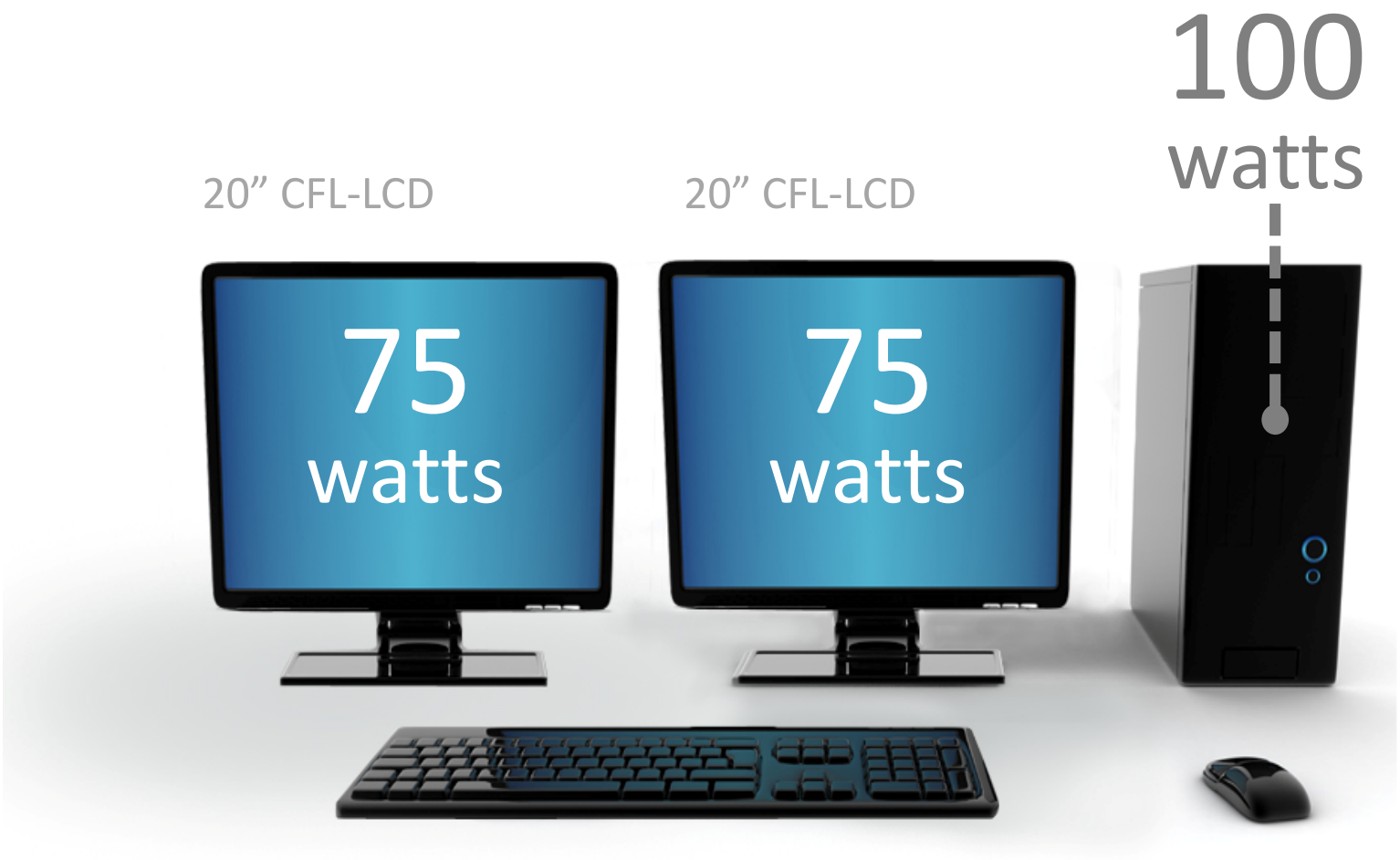
Thermal Requirements

Courtesy: Miller Hull

Occupants

Plug Loads - 2007

250 Watts



Occupants

Plug Loads - 2010

90 Watts

Occupants

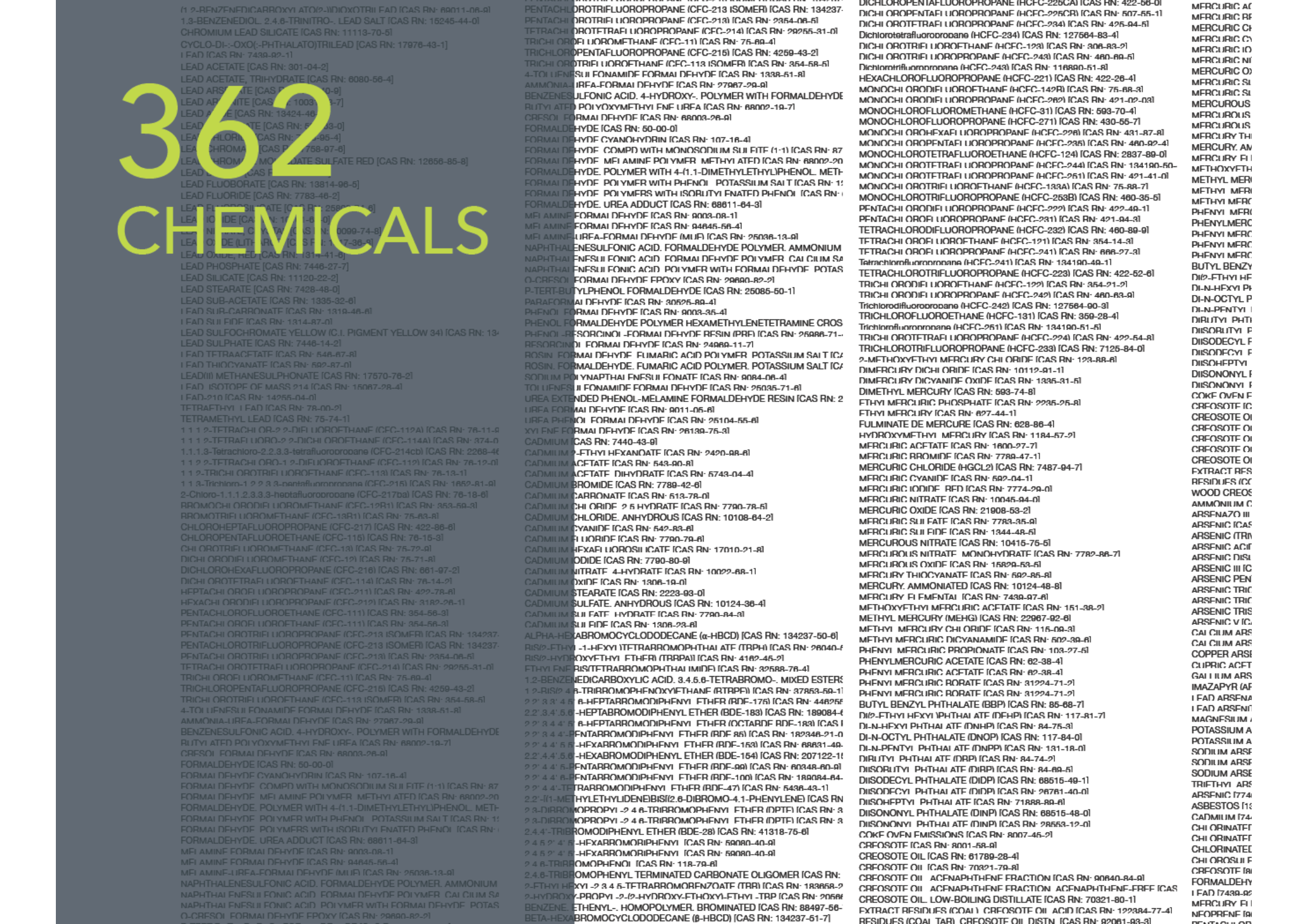
Plug Loads - 2011

42 Watts

AVOIDING THE RED LIST

SELECTING HEALTHY MATERIALS

Asbestos
Cadmium
Chlorinated Polyethylene
Chlorosulfonated Polyethlene
Chlorofluorocarbons (CFC)
Chloroprene (neoprene)
Formaldehyde
Halogenated Flame Retardants
Hydrochlorofluorcarbons (HCFC)
Lead
Mercury
Petrochemical Fertilizers and Pesticides
Phthalates
Polyvinyl Chloride (PVC)
Creosote, Arsenic Wood treatment


362
CHEMICALS

14 APPROPRIATE SOURCING

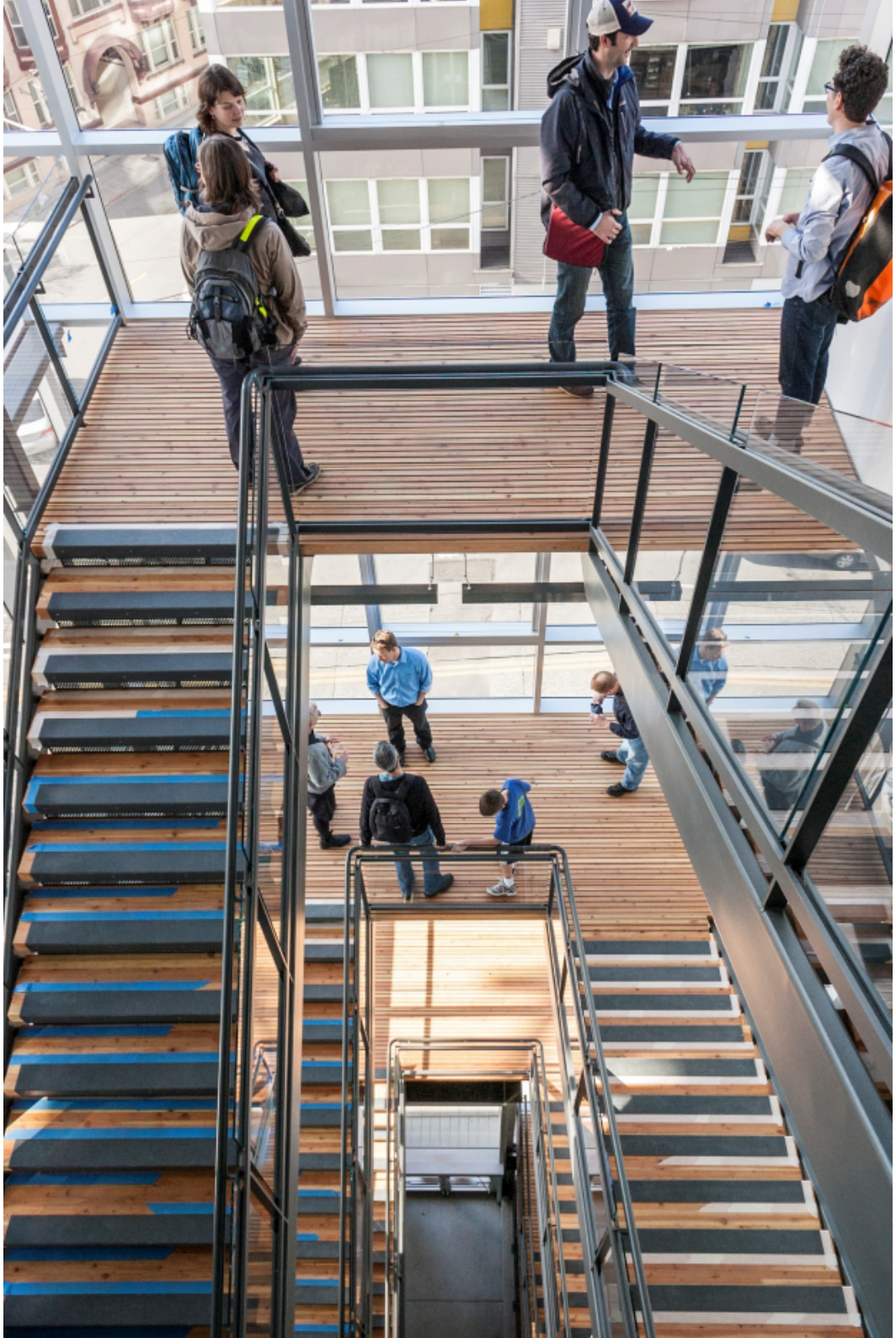
Source locations for materials and services must adhere to the following restrictions:

ZONE	MAX DISTANCE	MATERIALS/SERVICES	MASTERFORMAT 2004 CLASSIFICATION
7	20,004 km	Ideas	-
6	15,000 km	Renewable Technologies	Divisions: 42, 48
5	5,000 km	Assemblies that actively contribute to building performance + adaptable reuse once installed	Divisions: 08 (exterior), 11, 14, 22, 23, 26, 33, 44 Sections: 07 50 00, 10 21 23, 10 22 00, 10 70 00, 44 40 00
4	2,500 km	Consultant Travel	-
3	2,000 km	Light or low-density materials	Sections: 07 31 00, 07 33 00, 07 40 00, 09 50 00, 09 60 00
2	1,000 km	Medium weight or density materials	Divisions: 06, 08 (interior) Sections: 07 32 00, 09 20 00, 09 30 00, 12 30 00
1	500 km	Heavy or high-density materials	Divisions: 03, 04, 05, 31, 32


SIDEWALK
CLOSED

FSC CERTIFIED STRUCTURE

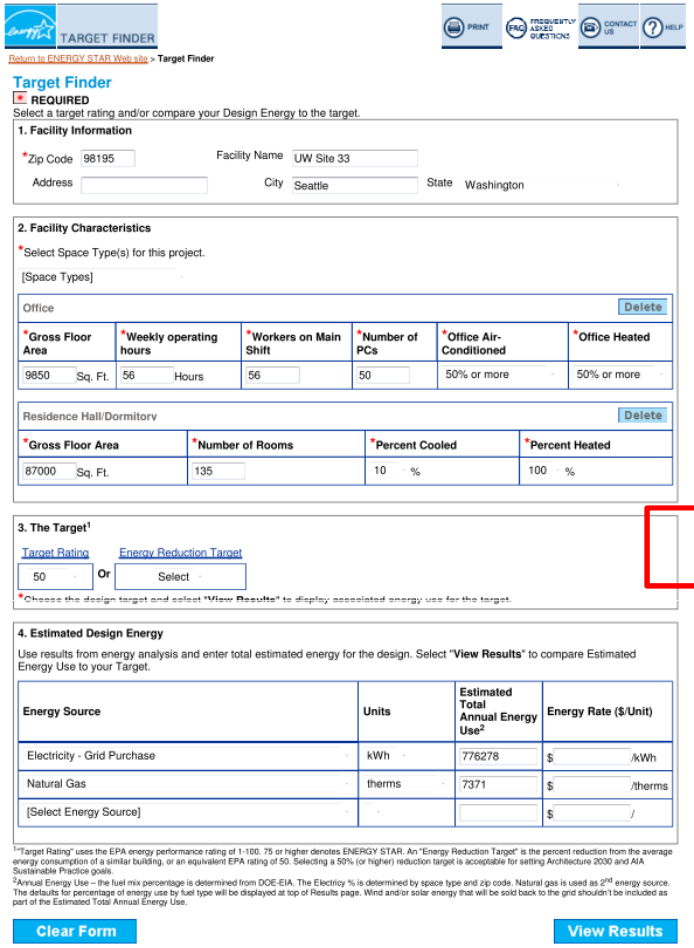
PROSOCO FASTFLASH



Steps towards Sustainability

Existing Facilities

ENTER TARGET FINDER



TARGET FINDER

Return to ENERGY STAR Web site > Target Finder

Target Finder

REQUIRED

Select a target rating and/or compare your Design Energy to the target.

1. Facility Information

*Zip Code: 98195 | Facility Name: UW Site 33

Address: | City: Seattle | State: Washington

2. Facility Characteristics

*Select Space Type(s) for this project.

[Space Types]

Office — Delete

*Gross Floor Area	*Weekly operating hours	*Workers on Main Shift	*Number of PCs	*Office Air-Conditioned	*Office Heated
9850 Sq. Ft.	56 Hours	56	50	50% or more	50% or more

Residence Hall/Dormitory — Delete

*Gross Floor Area	*Number of Rooms	*Percent Cooled	*Percent Heated
87000 Sq. Ft.	135	10 %	100 %

3. The Target[1]

Target Rating: 50 Or Energy Reduction Target: Select

*Choose the design target and select "View Results" to display associated energy use for the target.

4. Estimated Design Energy

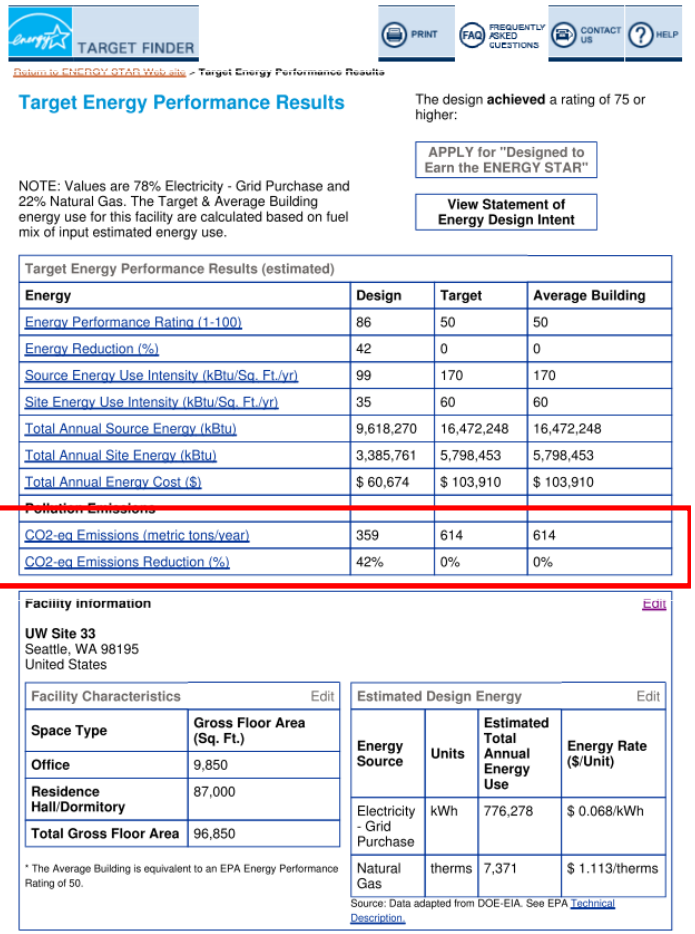
Use results from energy analysis and enter total estimated energy for the design. Select "**View Results**" to compare Estimated Energy Use to your Target.

Energy Source	Units	Estimated Total Annual Energy Use[2]	Energy Rate ($/Unit)
Electricity - Grid Purchase	kWh	776278	$ /kWh
Natural Gas	therms	7371	$ /therms
[Select Energy Source]			$ /

[1]"Target Rating" uses the EPA energy performance rating of 1-100. 75 or higher denotes ENERGY STAR. An "Energy Reduction Target" is the percent reduction from the average energy consumption of a similar building, or an equivalent EPA rating of 50. Selecting a 50% (or higher) reduction target is acceptable for setting Architecture 2030 and AIA Sustainable Practice goals.

[2]Annual Energy Use – the fuel mix percentage is determined from DOE-EIA. The Electricy % is determined by space type and zip code. Natural gas is used as 2nd energy source. The defaults for percentage of energy use by fuel type will be displayed at top of Results page. Wind and/or solar energy that will be sold back to the grid shouldn't be included as part of the Estimated Total Annual Energy Use.

Clear Form | View Results



TARGET FINDER

Return to ENERGY STAR Web site > Target Energy Performance Results

Target Energy Performance Results

The design **achieved** a rating of 75 or higher:

APPLY for "Designed to Earn the ENERGY STAR"

View Statement of Energy Design Intent

NOTE: Values are 78% Electricity - Grid Purchase and 22% Natural Gas. The Target & Average Building energy use for this facility are calculated based on fuel mix of input estimated energy use.

Target Energy Performance Results (estimated)

Energy	Design	Target	Average Building
Energy Performance Rating (1-100)	86	50	50
Energy Reduction (%)	42	0	0
Source Energy Use Intensity (kBtu/Sq. Ft./yr)	99	170	170
Site Energy Use Intensity (kBtu/Sq. Ft./yr)	35	60	60
Total Annual Source Energy (kBtu)	9,618,270	16,472,248	16,472,248
Total Annual Site Energy (kBtu)	3,385,761	5,798,453	5,798,453
Total Annual Energy Cost ($)	$ 60,674	$ 103,910	$ 103,910
Pollution Emissions			
CO2-eq Emissions (metric tons/year)	359	614	614
CO2-eq Emissions Reduction (%)	42%	0%	0%

Facility Information Edit

UW Site 33
Seattle, WA 98195
United States

Facility Characteristics Edit

Space Type	Gross Floor Area (Sq. Ft.)
Office	9,850
Residence Hall/Dormitory	87,000
Total Gross Floor Area	96,850

* The Average Building is equivalent to an EPA Energy Performance Rating of 50.

Estimated Design Energy Edit

Energy Source	Units	Estimated Total Annual Energy Use	Energy Rate ($/Unit)
Electricity - Grid Purchase	kWh	776,278	$ 0.068/kWh
Natural Gas	therms	7,371	$ 1.113/therms

Source: Data adapted from DOE-EIA. See EPA Technical Description.

www.energystar.gov

Steps towards Sustainability

Existing Facilities

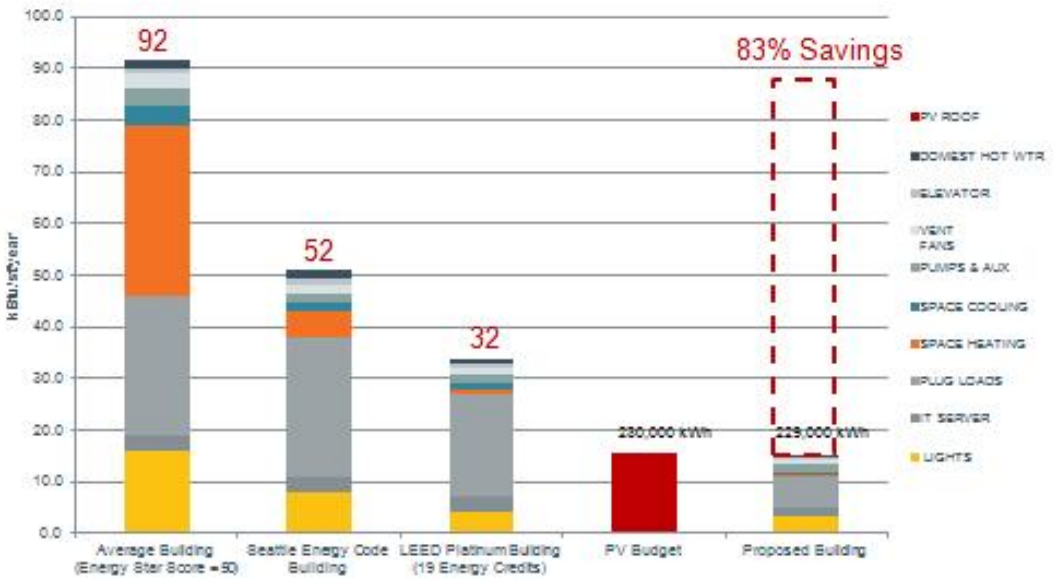
Commissioning/Retro-commissioning

Envelope, Mechanical, Lighting, Controls Upgrades

Renewables

Continuous Monitoring

Energy Use + Solar Budget



Margaret Sprug, Principal, AIA

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